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THESIS

A CONCEPT OF OPERATIONS FOR THE USE OF EMERGENT OPEN INTERNET TECHNOLOGIES AS THE BASIS FOR A NETWORK-CENTRIC ENVIRONMENT

by

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September 2006

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13. ABSTRACT (maximum 200 words)

The Industrial Age spawned a revolution that brought fundamental changes to the business of commerce, the structures of society, and the theories of warfare that are used to this day. With the dawn of the Information Age a similar revolution has begun, with the realization of the science of networks and their effects on complex systems, such as command and control and sharing information both internally and externally of a traditional military organization. Recognizing the power of Network-Centric Warfare, the US Military is transforming to develop that means. This has translated into the holistic requirement of agile, interoperable networks to achieve information superiority in fighting future wars and maintaining peace.

The purpose of this thesis is to provide a concept of operations for the use of emergent open Internet technologies as the basis for a network-centric environment. Examining current relevant research on networks and their application in the US military, a system of information systems will be presented to demonstrate current and potential capabilities in information sharing. Developing constructs such as web feeds, portals, blogs, and wikis will be used to create an interconnected framework for use with coalition partners, other government agencies, non-government organizations, and internal communications.

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TABLE OF CONTENTS

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LIST OF FIGURES

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LIST OF TABLES

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LIST OF ABBREVIATIONS, ACRONYMS, AND SYMBOLS

API	Application Programming Interface
ASD(NII)	Assistant Secretary of Defense (Network & Information Integration)
ATO	Authority To Operate
CCIR	Commander's Critical Information Requirement
CENTCOM	US Central Command
CICO	Combat Information Center Officer
CIFS	Common Internet File System
CNO	Computer Network Operations
CONOPS	concept of operations
COP	Common Operating Pictures
DITSCAP	Defense Information Technology Security Certification and Accreditation Process
DKO	Defense Knowledge Online
DoD	Department of Defense
DoD CIO	Department of Defense Chief Information Officer
EBO	Effects Based Operations
EW	Electronic Warfare
GIG	Information Grid
HA/DR	Humanitarian Assistance/Disaster Relief
HTTP	Hypertext Transport Protocol
IETF	Internet Engineering Task Force
IM	Information Management
IO	Information Operations
ISO	International Standards Institutes
ISR	Intelligence, Surveillance, and Reconnaissance
IW	Information Warfare
J2EE	Java 2 Platform, Enterprise Edition
JCR	Java Content Repository, JSR-170
JFCOM	US Joint Forces Command

JFCOM	US Joint Force Command's
JSR	Java Specification Request
JSR-168	Java Portlet Specification, Java Specification Request 168
JTF	Joint Task Force's
MILDEC	Military Deception
MNF-I	Multi-National Force Iraq
NCO	Network-Centric Operations
NCOWFA	Network-Centric Open Web Feed Architecture
NCW	Network-Centric Warfare
NGES	NewsGator Enterprise Server
NKO	Navy Knowledge Online
NPS	Naval Postgraduate School
OASIS	Organization for the Advancement of Structured Information Standards
OPSEC	Operations Security
OPSUM	Operation Summary
OSI	Open Systems Interconnect
P2P	person-to-person
PDF	Portable Document Format
PKI	Public Key Infrastructure
PSYOP	Psychological Operations
RDF	Resource Description Framework
RSS 1.0	RDF Site Summary
RSS 2.0	Really Simple Syndication
SPAWAR Europe	Space and Naval Warfare Systems Center Europe
SSAA	Systems Security Authorization Agreement
STRATCOM	US Strategic Command
TCP/IP	Transmission Control Protocol/Internet Protocol
UDOP	User Defined Operating Pictures
WSRP	Web Services for Remote Portals
WYSIWYG	What-You-See-Is-What-You-Get
XML	Extensible Markup Language

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I would like to thank CAPT Scot Miller and CDR Danelle Barrett for their mentorship and guidance in the world of Knowledge Management. Without their encouragement and willingness to listen to a junior officer or fulfill their capabilities as social hubs I would have never been able to tap into the Information Professional community's knowledge.

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I. INTRODUCTION

A. PURPOSE OF THE STUDY

The purpose of this thesis is to provide a concept of operations for the use of emergent open Internet technologies as the basis for a network-centric environment. This thesis examines current relevant trends on the Internet and in the US military as of July 2006. A system of information systems will be presented to demonstrate current and potential capabilities in the sharing of information. Emerging constructs such as web feeds, portals, blogs, and wikis are provided as a framework of how they might be used to create a network-centric, open-standards web feed based architecture for use with coalition partners, other government agencies, non-government organizations, and internal communications.

B. RESEARCH QUESTIONS

In researching emergent technologies and the sharing of information between multiple, disparate organizations a number of questions arose. This theses addresses these questions:

- How can Internet technologies based on open standards be used to facilitate a network-centric environment?
- How does one share actionable information with unknown users in a timely manner?
- Why should the US Military support open-source software?
- Why should the US Military support open standards?
- How can the US Military facilitate the further development of useful open standards and open-source software?
- How can the US Military efficiently share information with other government and non-government agencies in a network-centric environment?
- How can the US Military efficiently share information with multinational coalition forces in a network-centric environment?

C. MOTIVATION

In March 2003, I was deployed as a member of a small US Navy amphibious ship's crew as the Combat Information Center Officer (CICO) to the Arabian Gulf in support of Operation IRAQI FREEDOM. Some of my responsibilities as the CICO included staying knowledgeable on daily operations, as well as, compiling and presenting daily briefs on upcoming operations to the ship's leadership. To stay knowledge able on current operations, it is important to be abreast of particular operational messages. Unfortunately, with the large number of ships and operations in our ship's operating area, our message traffic was clogged with a multitude of messages, resulting in a delay of receiving important daily messages. Minimize was ordered to try and address this problem, but the technology and procedures our organizations were using could not meet the demand. Additionally, being a small ship with minimal command & control capabilities, our ship had minimal bandwidth and partial satellite blockages, which resulted in limited connectivity to our operational networks. Regularly, I was unable to receive messages in a timely enough manner to act upon them. Additionally, with the limited connectivity it was nearly impossible to check the Task Force Commander's website for the messages and briefs, because of the time the system required to be connected to download the webpage or file.

To compensate for our lack of connectivity, I used other tools that were available to me. Compared to the alternatives, electronic mail (email) and tactical chatrooms were extremely capable at getting through in a timely fashion, even with large file attachments. Chat transmissions were quick burst, so they could go through the network quickly and easily. Email would continue to download piece by piece, until the entire message was received. I reached out to people I knew on bigger ships with better connectivity to download and send me files. I sent blind emails to generic position accounts at other commands to ask them to add my address to a daily mailing list for relevant messages and briefs. I developed a social network to use the technology available to get the actionable information in timely manner, so that I could brief my ship on upcoming operations. In all honesty, pure luck and cooperation were the reasons this social network worked. A question formed in my mind, how could this system be made better and what if I had not been so lucky?

In August 2005, as part of the Naval Postgraduate School's detachment deployment in response to Hurricane Katrina's devastation among the Gulf Coast of the United States, I was presented with a similar problem. We needed a way to keep multiple geographically dispersed groups informed and connected with our chain of command in Monterey, CA, as well as each other. The mission of this team was to drive a mobile communications center from Monterey, CA to the Mississippi's Gulf Coast and provide telephone and Internet access to the local survivors, officials, and relief organizations.

Since we were providing Internet access; most of our teams would be able to access the Internet when they are trying to make reports. As the group's Knowledge Manger, I decided to use a prototype system based on open-source software, hosted on a personal server, for the different elements of our group to post information and collaborate. The prototype was my initial research into some emerging Internet technologies called wikis. (A wiki is best described as a web site that any legitimate user can edit.) The system was fairly successful; with little to no training, the user base grew to include a Hastily-Formed Network[1] of 135 different users.

Users ranged from a Seaman Recruit reservist looking to be a member of a team to the acting Assistant Secretary of Defense (Network & Information Integration) and Department of Defense Chief Information Officer (ASD(NII)/DoD CIO), Dr. Linton Wells II. Other users included watch officers and personnel from US Northern Command, US Joint Forces Command, Joint Task Force Katrina, and Naval Oceanographic Office; contractors and vendors from such companies as Microsoft, Cisco Systems, Northrop Grumman, MITRE, and Redline Communications; researchers from the Naval Postgraduate School, the Georgia Institute of Technology, the University of Louisville, and California State University, Monterey Bay; and even members of the press and responders from other organizations. All the users were able to read, add, and edit content, and many of them did so with little to no training or help. Additionally, web feeds were added. These feeds allowed for other compliant systems to monitor our Situational Reports without the user directly checking the system.

[1] The term "Hastily-Formed Network" in this context was first used by Dr. Peter Denning in 2004, and is articulated in Denning, Peter J. 2006. Hastily formed networks. Association for Computing Machinery. Communications of the ACM 49, (4) (Apr): 15.

From my experience during Operation IRAQI FREEDOM and our relief effort in the aftermath of Hurricane Katrina, I saw the potential for a new way to share information. I saw the foundation required to enable network-centricity in the Global Information Grid (GIG) and how to hastily develop a social and informational network in austere environments with our partners inside and outside of the Department of Defense's networks.

D. BENEFIT OF THE STUDY

The benefit of this thesis will be the conglomeration of emerging Internet constructs and ideas into a software architecture. This thesis serves to provide a framework for the reader to develop a general understanding of the basis of these technologies, how such technologies correspond to a network centric organization, and how these emerging technologies can be used in an operational environment.

E. METHODOLOGY

The methodology that was used to research this thesis consisted of the following:

1. Review current military systems and developing Internet technologies for useful Knowledge Management applications.

2. Conduct a literature search of Internet websites, applicable government documents, instructions, books, Joint doctrine and other information sources.

3. Develop a social network of knowledge practitioners, including academic researchers, operational military knowledge managers, military research commands, knowledge management communities of practice, and other relatively associated experts and organizations.

4. Determine applicable concepts and technologies based on experience as part of the Naval Postgraduate School's 2005 deployment in response to Hurricane Katrina and deployment of a prototype system.

F. ORGANIZATION OF THESIS

This thesis consists of several chapters which can be grouped into three main parts:

Chapter II embodies the "why." It describes the characteristics of the developing network centric world and the theories behind the US Military's shift to become a network-centric force.

Chapter III embodies the “how.” The system requirements for a network-centric, open-standards web feed based architecture and the synergistic characteristics of such an architecture are described. An example of how a system would work is provided.

Chapter IV and V embody the “what.” They describe the concepts and the nuts and the bolts of the individual systems within the larger system. Chapter IV describes the linkage, explaining how the different subsystems can be interoperable, provide flows of information, and easily share that information. Chapter V describes the content management of the system, explaining how the different subsystems can work together to develop data into information, and allow that information to be manipulated, and categorized, integrated, and used for collaboration.

Chapter VI concludes the thesis with directions for continued research on this topic and summarizes the concepts presented in this thesis.

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II. BACKGROUND AND RELATED WORK

A diverse selection of relevant concepts is presented in this chapter to provide a foundation of understanding how the architecture presented in Chapter III will work currently and into the future. In particular, this chapter touches on the developing notion of a *flatter world* and the US Military's response of Network-Centric Warfare. This flat world is one of cause (the technical connectedness of Web 2.0's social and informational capabilities) and effect (globalization of individuals), whereas NCW is a reorientation of the environment (or Domains of Conflict) and sciences (the science of networks).

A. THE FLAT WORLD

> Planet Earth has never been as tiny as it is now. It shrunk – relatively speaking of course – due to the quickening pulse of both physical and verbal communication. This topic has come up before, but we had never framed it quite this way. We never talked about the fact that anyone on Earth, at my or anyone's will, can now learn in just a few minutes what I think or do, and what I want or what I would like to do.[2]

This quote is from the short story Chain-Links, by Frigyes Karinthy, which was first published in Hungary in 1929 in a volume of short stories, entitled "Everything is Different." This is the first known reference to the relative shrinking of the world and the ideas behind social networks, such as small-world effects and six degrees of separation.[3]

Imagine sending a hand written letter between two neighboring cities. Logically, the shortest route between San Diego and Hong Kong would be a straight line, but it is actually a curved line along a great circle.

Imagine if instead of sending a hand written letter, a typed letter in an email is sent from one city to another. Does it really matter where in world the letter is headed? The email will reach its chosen destination in relatively the same time, as compared to the hand written letter, regardless of whether its destination is the neighboring city or on the other side of the globe. Whether through social or human-computer interactions, flows of information are no longer bounded to the physical world's geography. The physical

[2] M. Newman, Albert-Laszlo Barabasi, and Duncan J. Watts. 2006. The structure and dynamics of networks. Princeton studies in complexity. Princeton, N.J: Princeton University Press. 21.

[3] Ibid, 9.

domain of the world appears flat when compared to domains of information and social interaction. In the Information Age, every nation is a neighbor of every other nation, every city is a neighbor of every other city, and every person is the neighbor of every other person.

1. Globalization

In the start of Thomas Friedman's book, *The World Is Flat*, he describes three phases of globalization. He notes that Globalization 1.0 started with Christopher Columbus's sail in 1492 and his discovery of the new world, which subsequently began real global trade. During this phase of globalization, the world was large, but now fathomable, and the only entities that could afford to compete in such a world were nation-states.[4] Western nation-states recognized this new era and worked to grow their trade empires. The national powers of diplomacy, military, economy, and information were bounded to the muscles of manual labor and thus almost exclusively controlled by nation-states leaders, the controllers of the manual resource pool.

Globalization 2.0 was brought about by the uncoupling of national powers and natural strength. The Industrial Age began around the start of the 19th century with the introduction of hard technologies. Hard technologies were not powered by people or animals or other unfettered natural resources, but by sophisticated resources that had to be burned or manipulated to provide power. The continued introduction of hard technologies was an ever increasing catalyst for the Industrial Revolution, a change to the world's power structures.[5] National powers were no longer constrained by manual labor, and hard technologies were not only controlled by nation-states but also by companies. Companies could be multi-national, able to operate and collaborate globally without the bindings of a nation-state.[6] National powers were no longer strictly tethered to nation-states, but could also be controlled by multi-national companies to influence nation-states and other companies. National powers became diffused, no longer absolute and compartmentalized; they began to have grey areas in between. Professional soldiers were no longer exclusively required to wage war. With the assistance of hard technology,

[4] Thomas Friedman. 2005. The world is flat: A brief history of the twenty-first century. 1st ed. New York: Farrar, Straus and Giroux: 9.

[5] Walter Wriston. 1997. Bits, bytes, and diplomacy. Foreign Affairs 76, (5) (Sep/Oct): 172.

[6] Friedman, 9-10.

larger portions of a nation-state's population could be used in executing warfare, exemplified in the French development of *levée en masse*, the capability to amass huge armies. The world became relatively, progressively "smaller," measured by the decreased time it took for information to travel distances, using ships and trains, then planes and telecommunications.

Eventually, telecommunication systems have nearly developed and interconnected to a global saturation point, where the power of hard technologies has become less important than soft technologies that operated through them. The Internet was born and the cost for global connectivity began to shrink exponentially, resulting in an infinitesimal cost of connectivity that any individual in the world will be soon able to afford to access. This saturation point began the Information Age at the end of the 20th century. Just as hard technologies acted as a catalyst for the Industrial Revolution, the soft technologies of the Information Age are acting as a similar catalyst to the Information Revolution. Globalization 3.0 has begun where individuals are no longer required to be bound to companies or nation-states to operate globally. The capabilities previously contained in national powers and controlled by the elite, can now be influenced or controlled by individuals empowered by their knowledge. This fact was most potently made by the terrorist attacks of September 11, 2001 and the network of empowered individuals who instigated an act of war against arguably the world's strongest nation-state.[7] Although the US military was attacked on that day, it is important to note that the brunt of the attack focused on the citizenry and economy of the US, aimed directly at the US's national will and targeted only for the resulting effects.

With Globalization 3.0, information resources are becoming the most important. Unlike the resources of previous ages, information is not bounded by the physical domain. It can be irrelevant to its geographic location or its controller's relative size. An individual, or a network of individuals, can function unchained from nation-state governments or multi-national companies, and thus compete with them in projecting their influence globally. The world has become so interconnected and so relatively small, that nation-state sovereignty could be considered non-existent. No nation-state, no company,

[7] Friedman, 10-11.

can completely block the flow of information across national borders. Thus influence can be projected globally unrestrained by the scale of the sender. The current center of the mass of the most recent wave of globalization is the soft technological conglomeration of Internet constructs called Web 2.0.

2. Web 2.0

Web 2.0 is the culmination of current soft technological development on the Internet and supporting organizations processes. Coined by the publisher, Tim O'Reilly and his first conference held on the matter in October 2004. He invited different Internet pioneers to come together and discuss where the Internet was headed. Web 2.0 was a derivation of the "Web," the popular term used to describe the Internet during the first boom of Internet companies, "dot-coms." Several key themes emerged from the Web 2.0 inaugural conference:

- Services, not packaged software, with cost-effective scalability
- Control over unique, hard-to-recreate data sources that get richer as more people use them
- Trusting users as co-developers
- Harnessing collective intelligence
- Leveraging the long tail through customer self-service
- Software above the level of a single device
- Lightweight user interfaces, development models, AND business models[8]

a. Social Computing

The true power of the enable by Web 2.0 is the capacity for social computing. Social computing is based on the power of a group of users collaborating together to bring value to their common community's goals. For example, one of the early mainstream social computing systems was Napster. Napster was developed in 1999 by a 19 year old college student to help some friends download digital copies of music from the Internet. Napster was one of the first massive person-to-person (P2P) file sharing systems, made famous for the tens of millions of users swapping digital music

[8] http://www.oreillynet.com/pub/a/oreilly/tim/news/2005/09/30/what-is-web-20.html. (accessed August 1, 2006).

files.[9] Some may argue that Napster was not a pure P2P system, since it employed a server to provide an index of file locations, but it was the first system that entered the general public's consciousness and allowed users to massively share files with other users. Napster itself had no server where the shared files were stored, instead all of the files were stored on users' computers. Napster only showed people where to find them and facilitated in downloading them. Napster would have been useless without its users sharing their files, because there would have been no selection of music for users to download from.

b. The Degrees of Openness

A variable that is emerging in Web 2.0 soft technologies is its degree of openness. The degree of system openness will range from a proprietary system based on proprietary standards to an open-source system based on open-standards. There is also a comfortable medium where for-profit companies offer their systems, without support, under a fairly liberal open-source license and charge for consultation or advanced features. This profit model is easier for newer companies to adopt, as the older major companies have invested so many resources in their proprietary systems and support for legacy systems that they often perceive it is nearly impossible to make such a shift to open-source. These better established companies will sometimes view open-standards as inefficient alternates designed to compete with their proprietary formats. Arguably, proprietary formats have a tendency of being smaller, faster, or more feature capable. For this gain, however, they often sacrifice interoperability. The argument is that propriety standards can be interoperable as a de facto standard, as long as everyone uses their proprietary software or pays to use that standard. The logic of this argument of interoperable proprietary standards is similar to the notion of fixing an organizational "stove pipe", by building a bigger stove pipe. Companies with proprietary formats tend to deny competitor's access to using the formats, as is evident in Adobe's denial of Microsoft being able to directly convert Office documents in to Adobe's Portable Document Format (PDF).[10] These issues between competing proprietary companies can cause unreliable flows of information while shifting between formats. Additionally, by

[9] Duncan Watts. 2003. Six degrees : The science of a connected age. 1st ed. New York: Norton. 247.

[10] Adobe forces Microsoft to drop PDF from Office 2007. 2006. TechWeb (Jun 2): 1.

using proprietary formats an organization may have problems sharing information with other organizations, if they do not use the same format. If an organization is working to be interoperable and prepared to connect with the unintended users of another organization, it is imperative that the organization support open-standards.

Of course, as with any program, a program will only perform as well as the programmer wrote it and in the case of open-source code, the question of who programmed what and how much they tested it, is a serious one. Just because systems are open-source, however, does not directly mean they are insecure or less developed than proprietary systems. For example, if a system is open-source it can be openly improved upon and supported by outside organizations as is the case with the National Security Agency's modification of Red Hat Linux to create Security Enhanced Linux.[11] The US Joint Forces Command (JFCOM) is doing something similar with the eXo platform, as well as Space and Naval Warfare Systems Center Europe (SPAWAR Europe) with Drupal.[12] These systems can then be freely shared with other organizations without as many issues of acquisitions and copyright. Additionally, with unrestricted access to the source code, it could be argued that open source systems could be more secure due to the capability to review software line by line.

c. Flow of Information

One of the main differences between Web 1.0 and Web 2.0 instantiations is the flow of information. In the initial concepts of the World Wide Web, users went to web pages to get information. To get to a particular web page a user would follow a series of links provided through listing directories or search engines. Alternatively under the themes of Web 2.0, websites provide web feeds. Users do not go to information; rather information comes to them. Information is able to propagate from one system to the next through web feeds. Web feeds are covered in far greater depth in Chapter IV, but their use is a critical feature of Web 2.0 as they allow for the creation of dynamic information flows. This technology of web feeds allows for the migration from the Industrial Age way of pushing information (vertically through a hierarchical

[11] Jason Brooks. 2004. In operating systems we trust; review: Trusted solaris, SELinux limit damage hackers can do. EWeek 21, (36) (Sep 6): 43.

[12] Cheryl Lilie. 2005. Iraqi portal breaks coalition information barriers. Signal 59, (12) (Aug): 53.

http://www.pimswiki.org/images/1/11/PIMS_Transform_ICC.ppt slide 13 (accessed July 27, 2006).

organization) to the Information Age way of posting and smart pulling information (vertically, horizontally, and independently within a hybrid organization). This will be key for any organization, including militaries, to function in the Information Age.[13]

To give users even more accessibility and flexibility with the data inside of Web 2.0 type systems, they provide an open Application Programming Interface (API). The APIs provide the opportunity for other systems to use the functionality and capability of that system and provide it with others resulting synergistically in a better combined system. These combined systems are referred to as mashups. Mashups are systems that incorporate two or more other soft technology systems together to form a new system with additional functionality or capabilities.[14] Typical mashups provide methods of visualizing information, such as displaying the property value of different homes in a neighborhood overlaid on a mapping system of the area.[15]

d. US Department of Defense and Web 2.0

The constructs of Web 2.0 provide a wealth of new examples and ideas in the world of information. Currently, on DoD networks there is only minimal information flow, partly due the use of Web 1.0 constructs. The concepts and constructs inherent in Web 2.0 soft technologies will be critical to DoD information network practices in providing a foundation for the theory of Network-Centric Warfare.

B. NETWORK-CENTRIC WARFARE (NCW)

> On today's battlefield, we can witness new metrics being created that are the entry fee to the types of capabilities future forces must possess. These are access, speed, distribution, sensing, mobility, and networking. These are society's new metrics. They are scale free and valid at every level of warfare – tactical, operational, and strategic.[16]

The world changes embodied in the Information Age are as revolutionary as the fundamental changes that brought about the Industrial Age. For military forces, the Industrial Revolution became a catalyst for change, with sailing ships evolving into

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[13] David Alberts and Richard E. Hayes. 2003. Power to the edge : Command, control in the information age. Information age transformation series. Washington, DC: CCRP Publication Series: 120.

[14] http://en.wikipedia.org/wiki/Mashup_%28web_application_hybrid%29 (accessed August 26, 2006, history entry: 19:36, 26 August 2006).

[15] http://www.zillow.com. (accessed May 14, 2006).

[16] Anthony McIvor. 2005. Rethinking the principles of war. Annapolis, MD: Naval Institute Press: xi.

nuclear-powered submarines and aircraft carriers, cavalry into tanks and helicopters, and smooth bore rifles into nuclear weapons. Even the standard numbered organization of a US Joint Task Force staff had its origins in how Napoleon organized his staffs during start of the Industrial Age.[17] The Information Age is likewise serving as a catalyst for military change.

Network-Centric Warfare (NCW) is the embodiment of warfare in the Information Age. It is *not* about technology. It *is* about shifting the focus from the quantity of force to the interconnectivity of a geographically dispersed force. In other words, it is a synergistic concept where the whole is greater than the sum of its parts. Fittingly, Network-Centric Operations (NCO) is the application of the tenets and principles of NCW to military operations across the spectrum of conflict from peace to crisis to war. [18]

1. Origins

VADM Arthur K. Cebrowski is widely acknowledged as the intellectual "father" of NCW. The theory of NCW was first published in a 1998 US Naval Institute Proceedings article entitled, "Network-Centric Warfare: Its Origin and Future."[19] In this article, Cebrowski and Garstka described the revolutionary changes in American society and business caused by the developing effects of soft technology and the third globalization. In particular, the article recognized the changes that were occurring with business through the use of information technology, and how it was changing both their business process and economic principles. It was noted that this was caused by "three themes of change:

- The shift in focus from the platform to the network
- The shift from viewing actors as independent to viewing them as part of a continuously adapting ecosystem
- The importance of making strategic choices to adapt or even survive in such ecosystems"[20]

[17] Simon Atkinson and James Moffat. 2005. The agile organisation : From informal networks to complex effects and agility. Information age transformation series. Washington, DC: CCRP Pubs: 175.

[18] United States, Dept. of Defense and Office of Force Transformation. 2005. The implementation of network-centric warfare. Dept. of Defense, Office of Force Transformation. Washington, D.C: 27.

[19] Arthur Cebrowski and John J. Garstka. 1998. Network-centric warfare: Its origin and future. United States Naval Institute. Proceedings 124, (1) (Jan): 28.

[20] Ibid.

NCW is not a theory of how to win wars with technology. NCW is the holistic integration of skilled people, efficient processes, appropriately model organization, and the right technology into a force to achieve a decisive advantage. The theory of NCW is outlined by four tenets, which are described and illustrated in Figure 1.

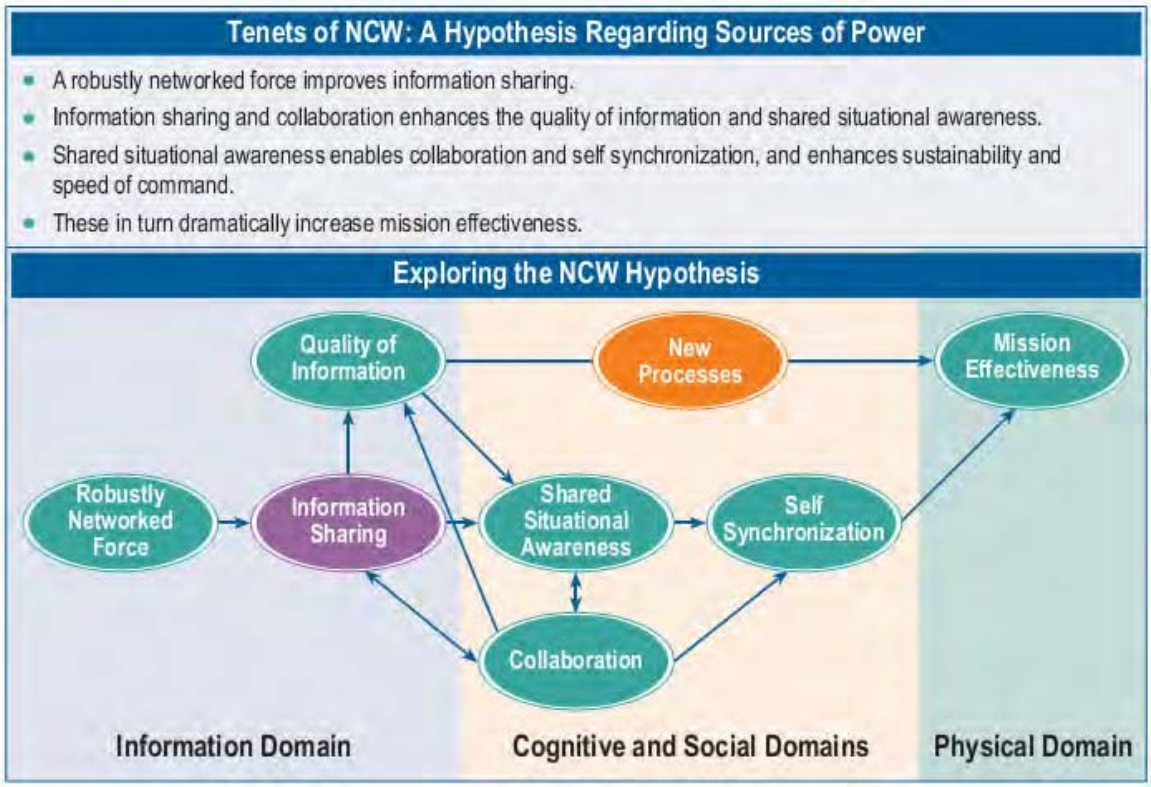

Figure 1. Description and Illustration of the Tenets of NCW.[21]

The Tenets of NCW provide the theory of how networks are a catalyst for improving in information sharing, shared situational awareness, collaboration, and self-synchronization. All of these capabilities provide quicker and more efficient mission accomplishment. Logically, one of the key enablers for network-centricity then is the efficient networking of a force internally and externally in all the Domains of Conflict.

2. Domains of Conflict

With the expansion of the capabilities to wage war outside of the physical domain, an expanded model is needed to describe the additional domains of warfare in the Information Age. Figure 2 is the conventional illustration of the Domains of Conflict. The Domains of Conflict consist of four interrelated and interdependent domains:

[21] The Implementation of Network-Centric Warfare: 19.

physical, information, cognitive, and social. NCW is the integration of the people, the processes, the organization, and the technology of a force operating in all four domains.

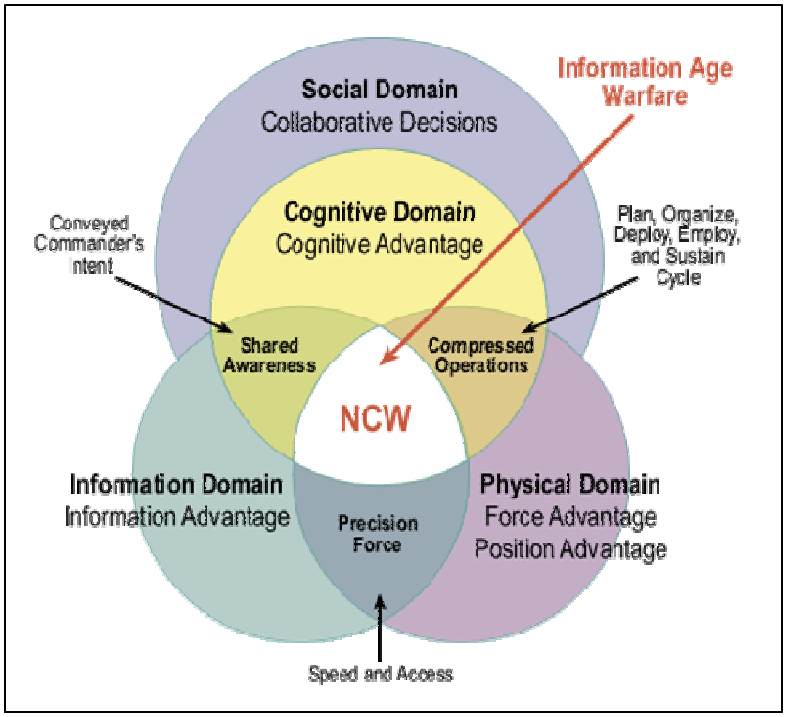

Figure 2. The Domains of Conflict in Information Age Warfare.[22]

a. The Physical Domain

The physical domain, the traditional domain of warfare, is the world of time and space, of kinetic operations. Even in NCW every element has some connection to the physical domain. Information is dissected into data and translated into electronic zeroes and ones that flow through routers. People physically exist in the physical domain, so although they think in the cognitive domain, interact with people in the social domain, and interact with information in the information domain, they must connect to the other domains through an interface in the physical domain.

b. The Information Domain

The information domain is the world of soft technology, the software that runs on computers and computer networks. It is where information is created, stored, and manipulated. In this domain information becomes mobile and travels from (physical) network to (physical) network. To better understand the philosophical boundary of a

[22] The Implementation of Network-Centric Warfare: 21.

network traversing between the physical domain and the information domain, it is helpful to review and use a reference model. For example, Figure 3, is the International Standards Institutes (ISO) Open Systems Interconnect (OSI) Reference Model. The OSI Reference Model is not a real network protocol, but it is the basic model for all other networks to follow, including the Transmission Control Protocol/Internet Protocol (TCP/IP), the network protocol the Internet uses. The general flow through the reference model from one system to the next is to encapsulate each layer in to the next, transfer the entire packet via the physical media, and finally pull off each layer as it moves up through the layers of the other system. By convention, it can also be viewed that one layer is virtually sending information to its related layer in the other system, however, it is physically going through all the lower layers and the physical network every time.

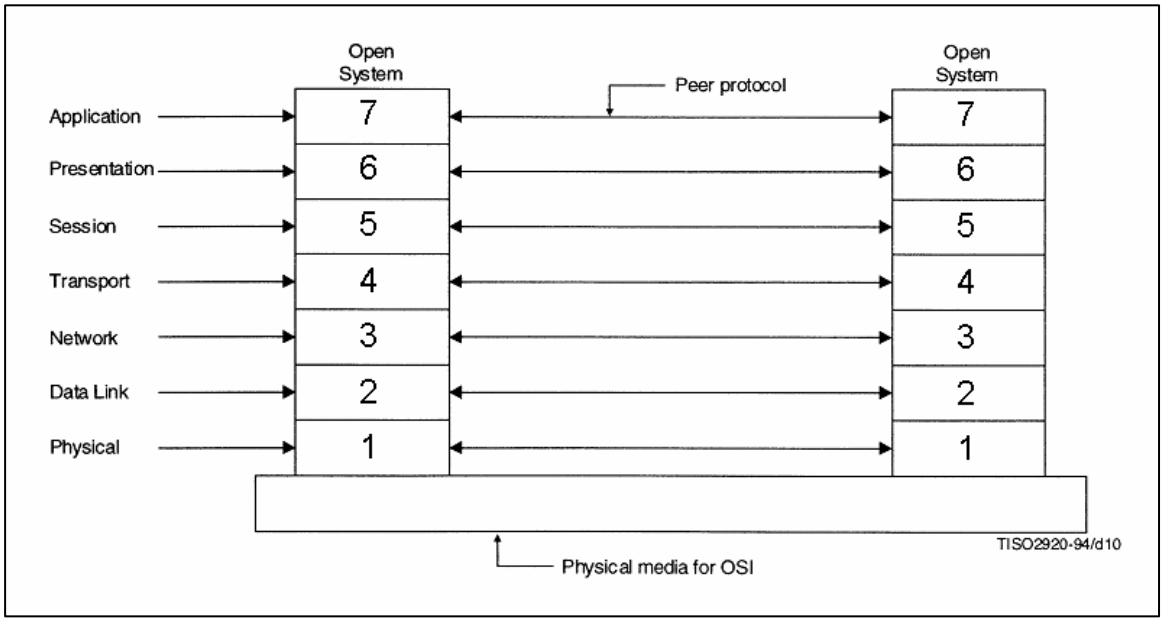

Figure 3. The OSI Reference Model.[23]

In the OSI Reference Model the divide between the physical and information domains exists between Layer 2, the Data Link Layer, and Layer 3, the Network Layer. Layers 1 and 2 are only relevant to moving data on the physical layer and can be programmed with hardware or software. Layer 3 is the computer's interface between the information and physical domain, as it is the address for the computer on the entire network. Layers 4 through 7 are only software relevant and so are purely in the

[23] After: ISO Standard 7498, ISO/IEC 7498-1:1994, Information technology -- Open Systems Interconnection -- Basic Reference Model: The Basic Model 2nd Edition: 28.

information domain. Layer 7 can all be seen as the interface between an information network and a container for information or data.

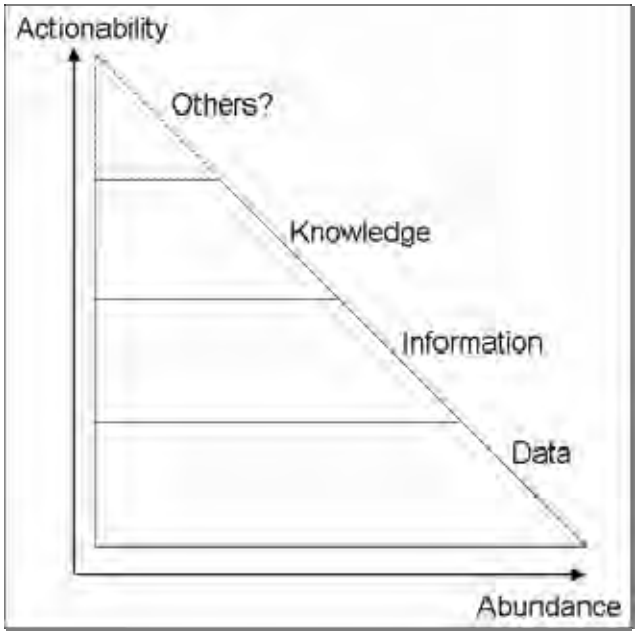

Figure 4. The Knowledge Hierarchy.

Figure 4 reflects Dr. Mark Nissen's Knowledge Hierarchy, a complimentary model that explains the storage of data, information, and knowledge. As data become information, and information becomes knowledge, they become more actionable, but less abundant. Like the OSI model, signals come into the Data Layer as recognizable symbols. If the symbols are unrecognizable, as in a foreign language, they are not considered data, regardless of whether the symbols were sent correctly. If there is context included with the data, then it can transfer up to the Information Layer. If the information can be related to an environment and can enable direct action, then it can transit to the Knowledge Layer. There are other concepts that could be put beyond knowledge, in particular understanding, however, it could be argued that understanding would exist in the upper parts of knowledge. To better facilitate its application, militarily, knowledge is defined as actionable information. [24]

Different types of knowledge can be categorized into one of two groups, explicit knowledge and tacit knowledge. Explicit knowledge is knowledge that can be

[24] Mark Nissen. 2006. Harnessing knowledge dynamics: Principled organizational knowing & learning. Hershey, PA: IRM Press. 16-20.

written. This may include written procedures, checklists, or reports. Tacit knowledge is knowledge that one has an understanding of. It is hard to write down and is primarily kept in the minds of people, such as a gut feeling or a general understanding. Generally, only data, information, and explicit knowledge can be stored in the information domain.[25]

To better explain the difference between the different layers, examine a datum: 20 knots. If one is familiar with nautical terms, they would recognize that 20 knots is probably the speed of something. Adding context to the data, such as the fact that speed of a ship equals 20 knots, enables the data to become information. With this information anyone can understand what is being said and could easily share this information with someone else. What enables this information to become knowledge is the incorporation of this information into the information environment and the knowledge base of the receiver. For example, if the ship traveling 20 knots is a contact off the side of a ship headed straight at them, then the officer driving the ship now has the knowledge to maneuver the ship to avoid the approaching vessel. The information is now actionable – it is knowledge.

Bringing all of these different concepts together, an integrated model of the information domain and its structures is portrayed in Figure 5.

[25] Nissen: 24-25.

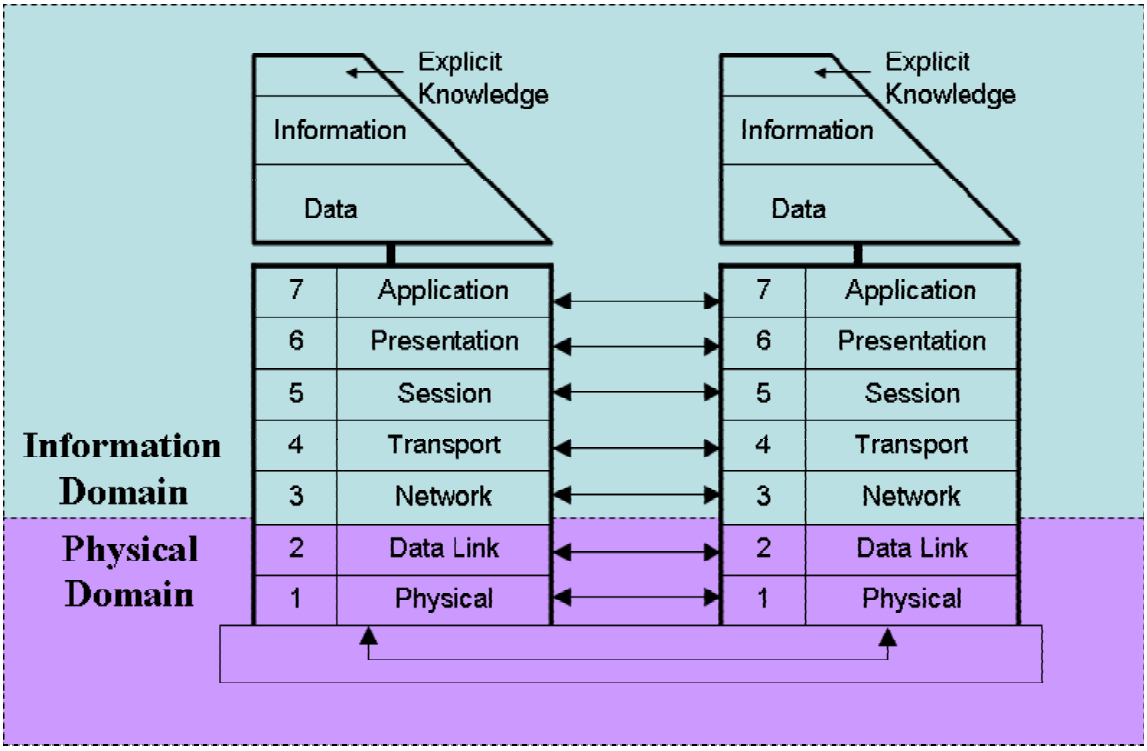

Figure 5. Combining the Knowledge Hierarchy and the OSI Reference Model.

c. The Social and Cognitive Domains

The social domain is the domain of human interaction. It is where people form social networks and interact. Although their interaction between people is bounded to travel through the physical domain, the social domain is able to maintain connectivity. The social domain is almost something of a wireless network, where people are able to form ad hoc groups and interact, as well as maintain social connections without physically observable ties.

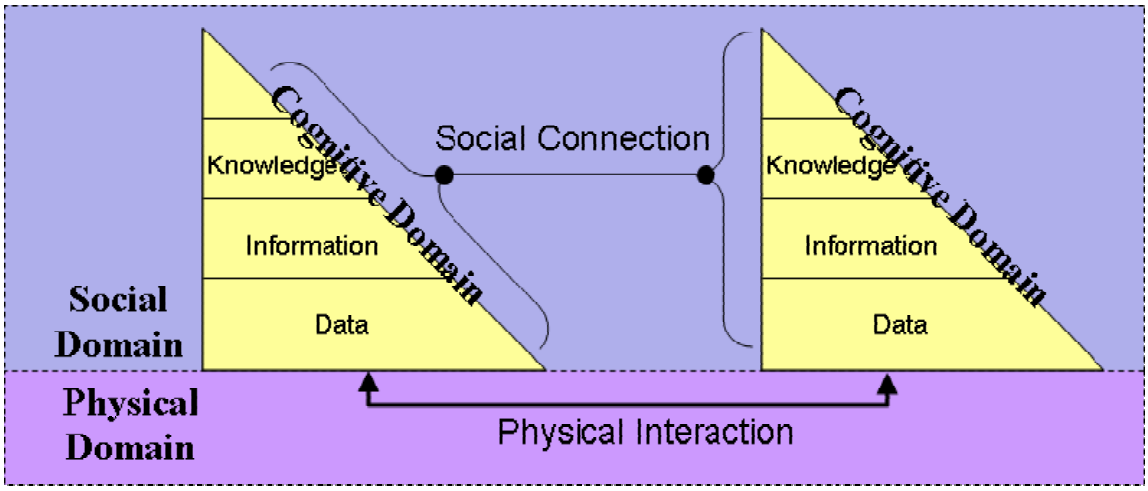

Figure 6. A Model of Two People Exchanging Knowledge.[26]

The cognitive domain is the minds of people. It is the target of Effects Based Operations and is bounded by the physical social domains. The Knowledge Hierarchy is also a good model for describing the cognitive domain. Figure 6 is an example of the structure of two people exchanging knowledge by talking to each other. A person's character: their core beliefs and values, culture, and self-awareness exists at the top of a cognitive domain, deep in the social domain. The interface between the cognitive domain and the physical domain, is the human senses colored by perceptions.

[26] After: Nissen: 21.

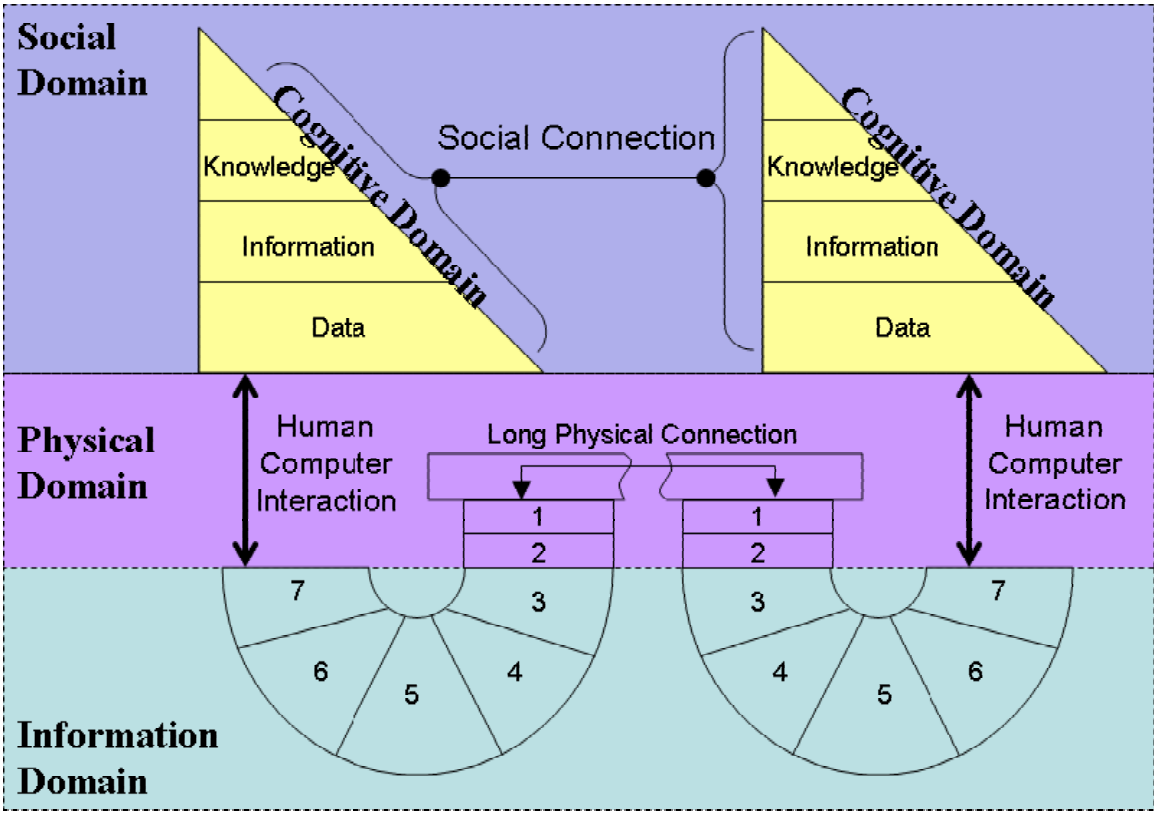

Figure 7. A Model of a Two Person Long Distance Social Interaction.

As can be seen in Figure 7, the true power of computer networks is that they not only allow for quick and easy access to information, but that they also allow for the ability to have extended social connections. These extended social connections are relatively unbounded by the restrictions of the physical domain. Although all of the domains must go through the physical domain to interact, they are no longer limited to a portion of the physical domain. One can go as far away as they want from someone else, but if they can both gain a connection, they are able to also access the social and information domains in real-time, unhampered by their geographical restrictions.

3. The Science of Networks

The emergence of networks in the average person's daily life has fueled an explosion in the research of the structure and dynamics of networks. This multi-disciplinary research has remained unlimited to a particular domain investigating social, informational, and physical networks and how they apply to the people, the processes, the technologies, and the organizations of the Information Age.[27] This research has resulted

[27] Albert-Laszlo Barabasi. 2002. Linked : The new science of networks. Cambridge, Mass: Perseus

in the discovery of the notion of several networks that have evolved from random networks and can be categorized by their average path lengths and clustering coefficients. The average path length being the average relative distance of connections between nodes in a network and the clustering coefficient being the ratio of how interconnected the nodes in a network are. A short path length is a connection between two neighboring nodes and inversely, a long path length is a connection between two nodes on the opposite side of a network. The clustering coefficient can be determined by dividing the number of connections in the network by the number of possible connections. A clustering coefficient near one means most of the nodes are strongly interconnected, where a clustering coefficient closer to zero means that there are only a few nodes connecting the network together.[28]

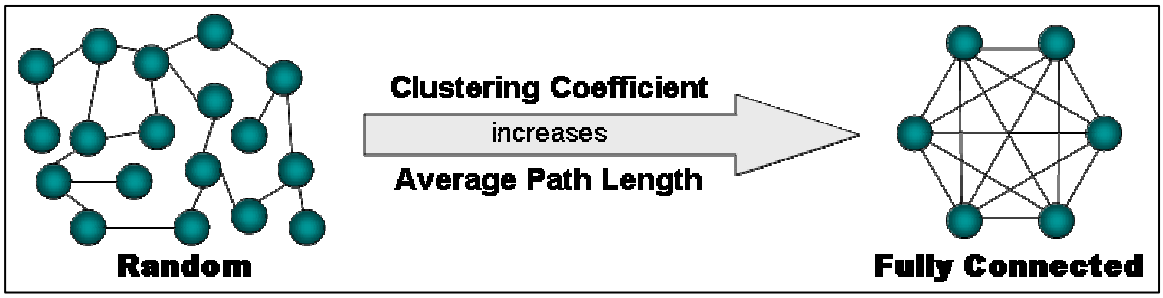

Figure 8. The Relationship of Random and Fully Connected Networks.

Figure 8 portrays two extremes of connected networks: random networks at one with a minimal clustering coefficient and a low average path length, fully connected networks, with a clustering coefficient of one and a higher average path length. Between these two extremes exists the notion of small world networks.

a. Small World Networks

Small world networks typically have a moderate to very large clustering coefficient, but they are scattered as neither randomly as a random network nor as solidly connected as a fully connected network. The theory of how small world networks form connections is based on the relativity of one node to another, in particular, how many

Pub.

Friedman.

Malcolm Gladwell. 2000. The tipping point : How little things can make a big difference. 1st ed. Boston: Little, Brown.

Watts (2003).

[28] Duncan Watts and Steven H. Strogatz. 1998. Collective dynamics of 'small-world' networks. Nature 393, (6684) (Jun 4): 440.

connecting nodes one node might have in common with another. For example, two people are more likely to meet based on the number of mutual acquaintances they have.[29] Figure 9 is an example of a small world network, and in particular what is referred to as a scale free network.

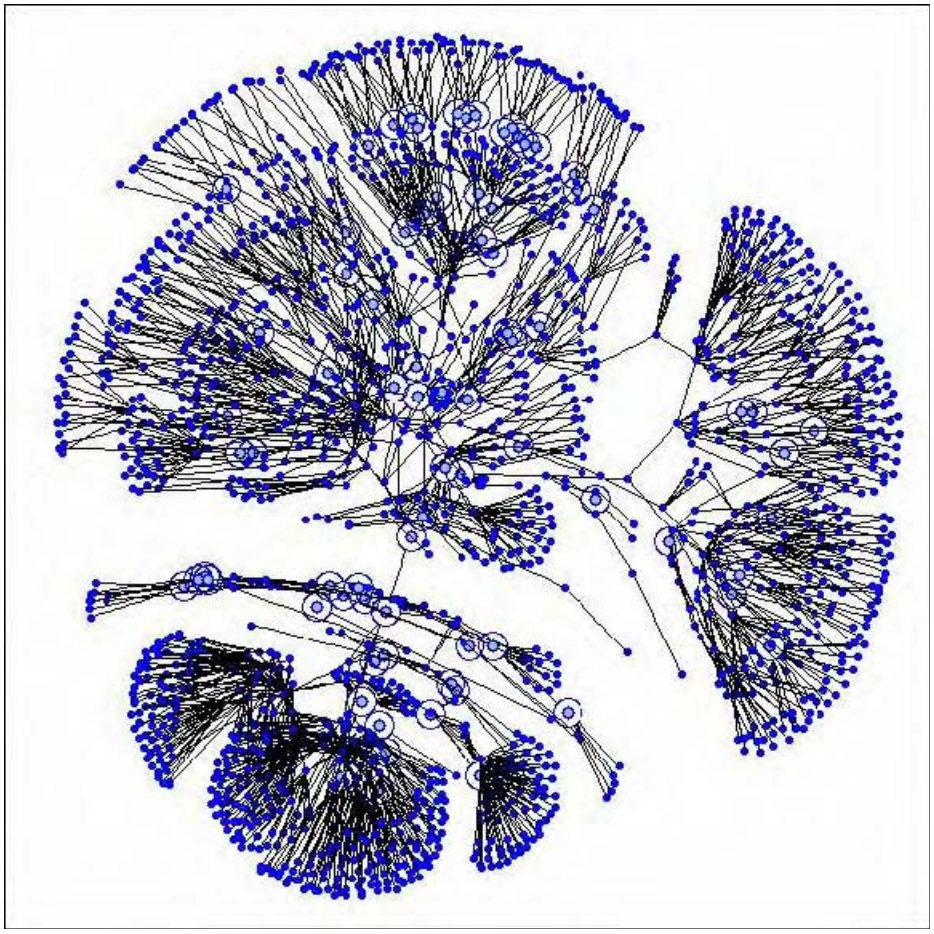

Figure 9. The Opte Project's Partial Map of the Internet, November 12, 2003.[30]

b. Scale Free Networks

Although there is some disagreement of the relation of scale free networks to small world networks, scale free networks can be seen as a subset of small world networks. Small world networks can be evolve from or into scale free networks, as they are networks with moderate to high clustering coefficients, but lacking long distance

[29] Duncan Watts. 1999. Networks, dynamics, and the small-world phenomenon. The American Journal of Sociology 105, (2) (Sep): 493.

[30] http://bitcast-a.bitgravity.com/blyon/opte/maps/static/1068668226.Graphviz.2D.1884x1884.jpg (accessed August 9, 2006).

connections that characterize scale free networks and their resulting power law distribution.[31] The long distance connections of a scale free network typically connects roughly twenty percent of the network's nodes, these long haul nodes are called hubs, because other roughly eighty percent of the nodes will typically connect to them in great numbers.[32] This type of layout allows for quick hops across a large network. As there is no limit to size of path lengths and the number of connections per node, the network can be described as scale free.[33] Figure 10 illustrates the difference between a scale free network and a random network.

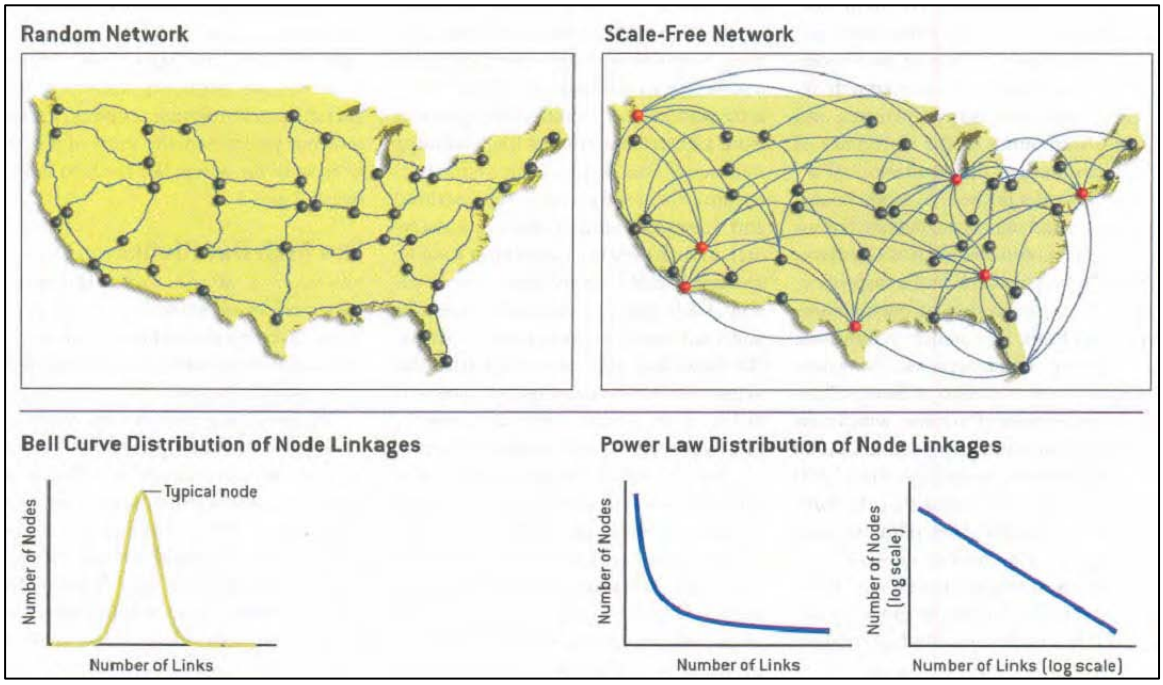

Figure 10. Random Networks vs Scale-Free Networks.[34]

For example, comparing how a number of cities in the US are connected by the highway systems versus the commercial airline systems. There can only physically be so many highways that can physically connect to any one city; however, there can be a far greater number of airline routes connecting a city. Additionally, cities can be connected by airline routes, without traveling through other cities. In a random network,

[31] David Alberts and Richard E. Hayes. 2006. Understanding command and control. Future of command and control. Washington, D.C: CCRP Publications: 106.

[32] Barabási (2002): 65-78.

[33] David Alberts and Richard E. Hayes (2006): 104.

[34] Albert Laszlo Barabasi and Eric Bonabeau. 2003. Scale-free networks. Scientific American 288, (5) (May): 53.

nodes are limited in the connections, or links, they can have due to a random network's characteristically low clustering coefficient and short average path length. Graphing the number of nodes versus the number of links per node results in a bell shaped graph that can provide an upper bound to the number links an average node may have. There will be some nodes that have fewer connections and there are some nodes that have more connections, but no extremes. Alternatively, graphing a scale free network, there is a different distribution of node connections that can be described as power law distribution. There are many nodes with a few links, but there are hubs that are highly connected with long distance links.[35]

The power law distribution of a scale free network is due to the idea of "preferential attachment" of a new connection in a network where there is a preference of making a connection to a node that is already well connected. Preferential attachment is observed to occur as the network grows either by adding a new node or another connection between existing nodes.[36] For example, in the system of commercial airline routes, if a new city was added, what would be the best city to connect it too? Logically, it would be the city with the most connections already. This is different to a random network, like a highway system, where the logical connection of a new city would be to neighboring cities. As compared to a generic small world network example of where people form connections based on mutual acquaintances, in terms of scale free networks, the people with most acquaintances are more likely to meet new people and act as a conduit to other groups of people not connected to an already highly connected group. It is believed that preferential attachment is what drives the development of a scale free network's characteristically small number of highly connected nodes with some very large path lengths and a high clustering coefficient from the less connected nodes. [37]

As a result of its different distribution of connectedness, scale free networks are more robust than random networks in terms of accidental failures or random attacks. The logic behind this is that an arbitrary node in a random network would be well

[35] Barabasi (2002): 71.

[36] Albert-Laszlo Barabasi and Reka Albert. 1999. Emergence of scaling in random networks. Science 286, (5439) (Oct 15): 509.

[37] David Alberts and Richard E. Hayes (2006): 101-102.

connected, where an arbitrary node in a scale free network would only have a few connections. So if an arbitrary node accidentally fails or is randomly attacked, then a scale free network is more likely to fully function as compared to a random network. Inversely, scale free networks are more vulnerable to targeted attacks as compared to random networks, if an attack is targeted at highly connected node, it will be more devastating to the network than in a random network.[38] Arguably, although a scale free network is more vulnerable to targeted attacks, it also reduces the requirement of resources required to defend the network, allowing for an administrator to focus more on the higher connected nodes, versus all of the nodes in a random network.

There has not been a study comparing the robustness and security of scale free networks versus other small world networks, however, since their properties are fairly similar, then logically, they are at least both more robust and less fault tolerant than random networks. It would then be rational to observe that as the clustering coefficient goes up, so would robustness against failures both intentionally and unintentionally. Following the correlation of robustness to the clustering coefficient, then it would also be logical to assume that small world networks are more robust than scale free networks, and that fully connected networks are more robust than both of these networks.

c. A Hybrid Network for Command and Control

To operate as one networked force of coalition partners, different government agencies, and non-government organizations, a conglomeration of different types of networks will be required. The key to a successful flow of information and enacting Command and Control in the Information Age will be the shift from the stereotypical Industrial Age hierarchical network that is completely stovepiped, to a global hybrid network. Taking the top-down view the hybrid would appear to be a scale free network. Taking a bottom-up view the hybrid would appear to be a fully connected network. Somewhere in between these two views, the hybrid would appear as a small world network. The trend in this hybrid would be that the closer that one gets to the tactical environment, the higher the clustering coefficient will become, while the closer

[38] Reka Albert Hawoong Jeong, and Albert-Laszlo Barabasi. 2000. Error and attack tolerance of complex networks. Nature 406, (6794) (Jul 27): 378.

that one gets to the strategic environment, the clustering coefficient decreases, but hubs appear with long path lengths that connect through out the network.[39]

Understandably, as information is generated by the fully connected networks at the edge of a global network, there would be overlap and inconsistencies. As the information moves from the edge to the core it would be best to be correlated and refined, to avoid overloading the core with information from too many nodes generating the same information. Alternatively, at the edge of the network it is important that it be more fully connected. In a tactical environment it is imperative that a network centric force is able to have shared situational awareness and self-synchronize. Through this hybrid network information would be able to flow quickly to and from decision makers at all levels and facilitate the concepts that are enabled by network-centricity.

C. CONCEPTS ENABLED BY NETWORK-CENTRICITY

Network-centricity is not the end to a means; it is a means to an end. Network-centricity is an enabler. Organizations that are network-centric do not accomplish their goals simply because they are network-centric, but they arguably accomplish them more efficiently by being so. Network-centricity enables an organization to be more efficiently *effects-based*, to better facilitate empowering the *edge* portion of an organization, and to be more capable of developing *decision superiority*.

1. Effects Based Operations (EBO)

One of the products of the third globalization is the integration of the world's information environment. The US Military can no longer only function in the physical domain, but must expand into the other three Domains of Conflict. They must look holistically to solve a problem and not bluntly apply the necessary military strength to accomplish their goal. In the Information Age, the military must be a part of the solution, not the sole solution. As is evident by the comparative massive casualties of insurgents and terrorists in the Global War on Terrorism and yet the inability to unanimously declare victory, a paradigm shift has been demonstrated as a necessity. In particular, a shift from the theories of attrition based warfare to theories of effects based warfare.[40]

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[39] David Alberts and Richard E. Hayes (2006): 107.

[40] Edward Allen Smith. 2002. Effects based operations : Applying network centric warfare to peace, crisis, and war. Information age transformation series. Washington, DC: DOD-CCRP: 2-58.

The emergence of Effects Based Operations (EBO) has been the prime concept of operations for this paradigm shift. EBO is "sets of actions directed at shaping the behavior of friends, neutrals, and foes, in peace, crisis, and war."[41] It cannot be limitedly applied to only the military portion of national powers, but must be fully applied in terms of diplomacy, information, and economy, as well. EBO is not a replacement of other types of warfare, but is a shift from focusing on only the direct means of accomplishing a goal, to additionally examining the indirect means to accomplishing the same goal.

For EBO to be effective there are two resulting requirements: maintaining shared situational awareness for the involved decision makers and a feed back loop to this situational awareness. The feedback loop is critical, because with EBO, it is hard to measure quantifiable results and can be dependent on results generated from a cascade of intended effects caused by a particular action. Cascading effects can also have unintended effects, hence the need for consistency and real-time feedback to hedge against potentially undesirable consequences. NCO facilitates the capability for an efficient shared situational awareness and feedback loop. A "Community of Interest" can provide consistency for decision makers, particularly when new members join an operation.

2. Information Superiority

Information Superiority is "the operational advantage derived from the ability to collect, process, and disseminate an uninterrupted flow of information while exploiting or denying an adversary's ability to do the same."[42] Information Warfare (IW) can be interpreted as the fight to win Information Superiority. For Information Superiority to be achieved, three separate areas must be efficiently brought together, which are listed as follows:

- **Intelligence, Surveillance, and Reconnaissance (ISR)** is an activity that synchronizes and integrates the planning and operation of sensors, assets, and processing, exploitation, and dissemination systems in direct support of current and future operations.[43]

[41] Smith: 108.

[42] The Joint Chiefs of Staff. Joint Publication 1-02, Department of Defense Dictionary of Military and Associated Terms. Washington, DC, 2006: 259.

[43] The Joint Chiefs of Staff. Joint Publication 2-01, Joint and National Intelligence Support to Military Operations. Washington, DC, 2004: GL18-GL19.

- **Information Management (IM)** is the controlling and prioritizing of information through its life cycle – creation or collection, processing, dissemination, use, storage, and disposition.[44]

- **Information Operations (IO)** is the integrated employment of electronic warfare (EW), computer network operations (CNO), psychological operations (PSYOP), military deception (MILDEC), and operations security (OPSEC), in concert with specified supporting and related capabilities, to influence, disrupt, corrupt, or usurp adversarial human and automated decision making while protecting our own.[45]

Information Superiority can be seen as a balance where ISR brings information in, IM categorizes and shares that information, and IO protects friendly information and attacks enemy information. Information Superiority cannot be achieved without all three. It should be noted that each of the three subparts of Information Superiority calls for the use of a network. In the terms of ISR, it calls for synchronizing, integrating, and disseminating. In terms of IM, it calls for controlling and disseminating. In terms of IO, it calls for integrating and synchronizing. By breaking down these subparts, it is apparent that network-centricity facilitates Information Superiority by providing shared situational awareness and self-synchronization to decision makers.[46]

3. Power to the Edge

At the beginning of the Industrial Age, nation-states began amassing large armies. To command and control these forces, they were organized into a hierarchy, following the general rule of thumb of one superior controlling five subordinates, plus or minus two. [47] This organization has continued to this day as an army will generally consist of three to four corps, a corps of three to four divisions, a division of three to four brigades, a brigade of three to four battalions, a battalion of three to four companies, a company of three to four platoons, a platoon of up to four squads, a squad of two to three fire teams, and a fire team of five to six soldiers. To control such an organization and the many

[44] The Joint Chiefs of Staff. Joint Publication 6-0, Joint Communications Systems. Washington, DC, 2006: II-2.

[45] The Joint Chiefs of Staff. Joint Publication 3-13, Information Operations. Washington, DC, 2006: ix.

[46] The Implementation of Network-Centric Warfare: 55.

[47] Ibid: 77.

different layers of middle management, adhering to the "chain of command" was established.[48] Even with email and tactical chat, it is typical to "CC" or send a copy of what was sent to the unit commander, for their reference. Information flow is used to control a hierarchical organization. When official messages are sent to a command, regardless of whom in particular the message might actually be intended for, it is still sent to the commanding officer.

With early Industrial Age communication capabilities, a hierarchy organization makes sense. How else would a major commander promulgate his plans and intent, without such a system? There was no way to speak specifically to individuals throughout the chain of command and communication systems were rather limited to the point they needed to be centrally controlled. Major operations had to be divided up, to be organized and accomplished. As communication systems have developed they have adhered to the processes and organizations that were already established. In essence, following tradition unhampered by progress. Needless to say, if something works, why change it? Especially, when it is confusing and a waste of resources to change for the sake of change. The problem that has formed along these traditional lines is the matter of decision making. Originally, it was up to the on site commander to determine his superior's intentions and follow through to accomplish the intended goals. Whether the mission was accomplished and whether a battle was won or lost was sometimes more or less based on luck.

As technology improved sensors and communications, commanders became better informed. The concentration, however, of improved capabilities has been at the top of the hierarchy and worked its way down. With the dawn of the Information Age, technology has begun to reach a saturation point on the battlefield. At the tactical level, although soldiers are loaded up with communications gear to stay connected, the decision-making often remains higher up the hierarchy. Power to the edge is the "empowerment of individuals at the edge of an organization." This edge is where the organization or its systems meet the operational environment. To empower these

[48] David Alberts and Richard E. Hayes (2003): 42-43.

individuals, they must be supplied information and unconstrained from multiple layers of control.

Bringing the power to the edge of an organization is a necessity in the Information Age, where effects are realized by not just a simple hierarchy, but a mesh of different military services, coalition partners, other government agencies, and non-government agencies. Additionally, as technology has increased the battle rhythm of organizations and broadened the areas of responsibility, it has also exposed the edge to make strategic decisions regardless of location in the hierarchy. Technology now enables shifts away from hierarchies as the only military organizational model. In the Information Age, tactical decisions can be made at the strategic level, and strategic decisions can be made at the tactical level. For an organization to succeed in this type of decision environment, if decisions are going to be made at the tactical level, then the system should facilitate rather than hinder.

III. CONCEPT OF OPERATIONS

This chapter provides a concept of operations (CONOPS) of a Network-Centric Open Web Feed Architecture (NCOWFA). To provide context for the CONOPS, it is framed with the perspective that a Humanitarian Assistance/Disaster Relief (HA/DR) Operations is the worst-case scenario for sharing information. There are a diverse set of examples presented in this chapter for other potential use cases, however, sharing information in any other environment will be more homogenous than HA/DR.

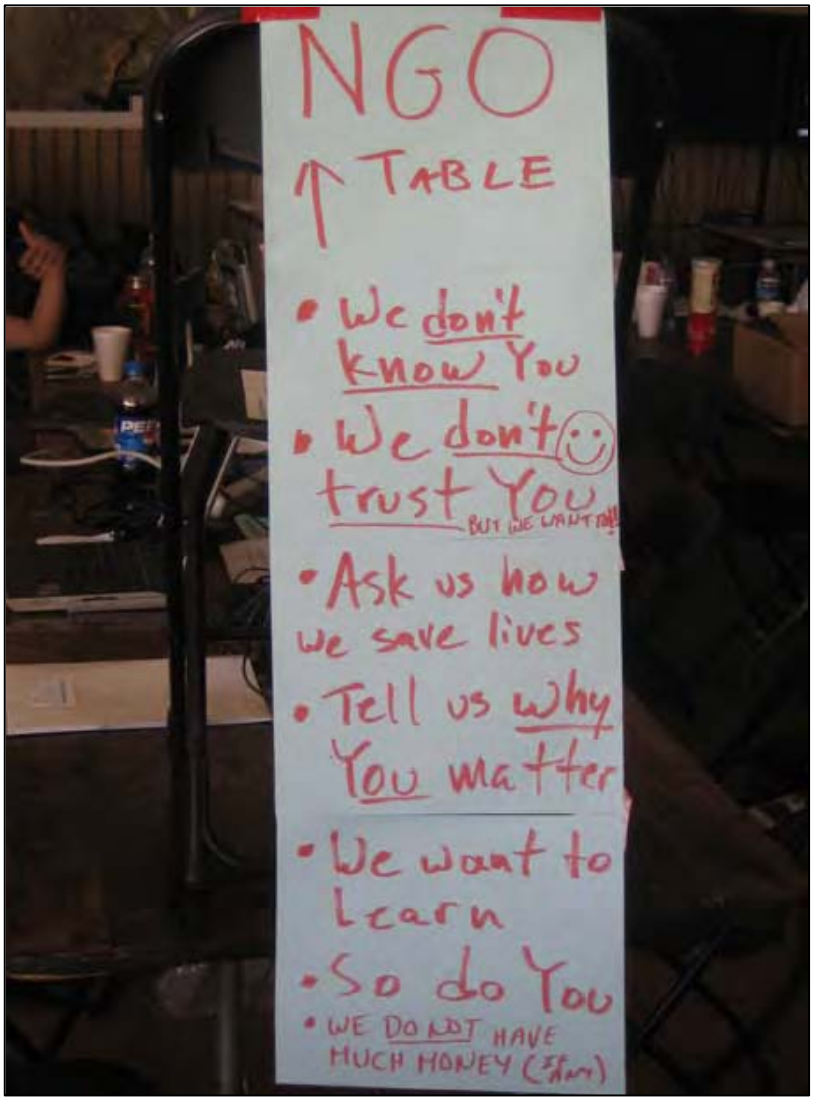

Figure 11. The Sign for the NGO Table at an HA/DR exercise.[49]

[49] Susan Higgins. 2006. Personal Picture from HA/DR Exercise, Strong Angel III, dated August 25, 2006.

The logic of why HA/DR operations are among the hardest to support in terms of developing a network-centric framework is that there is no predetermined control over users or their requirements. It is likely that users will be inexperienced, using dated technology, and potentially unable to install software on their systems. Additionally, each involved organizations is likely to be different in every domain. It is possible that other organization do not want to work with the military, as demonstrated in Figure 11. The same model for HA/DR operations can be extended for other cases, because it is the worst case scenario in terms of information sharing.

A. MINIMUM REQUIREMENTS OF A NETWORK-CENTRIC ENVIRONMENT

Joint Publication 6-0 defines four key characteristics of Joint communications: interoperable, agile, trusted, and shared.[50] In terms of the theories of NCW, all four of these elements are the foundation for a network-centric environment. In terms of current HA/DR operations, trust between users would be potentially very low, while the sharing of information will need to be potentially very high. This presents a paradox for information sharing. It results in the need of sharing information with unknown users, driving the requirement of robust interoperability and agility in a supporting system.

To enable robust interoperability and systems that share information with unknown, uncontrollable users, open-standards for sharing that information are imperative. It is additionally critical that those open-standards are supported by open software that can be easily shared with such users. The concept behind system openness was discussed in Chapter II. To be interoperable with unintended users, (as in a worst case information sharing environment such as a HA/DR) a network-centric system must robustly support open-standards throughout the system. This foundation of open-standards allows for a smooth information flow between many disparate organizations. If a system does not support open standards, then the system is in actuality a very large, fully-connected, but non-network-centric stovepipe.

In terms of agility, a system supporting HA/DR operations needs a higher degree of flexibility and adaptability than more traditional military systems which are intended

[50] JP 6-0: I-9.

for use by known users. In particular, military systems have usually been custom made and rather expensive. In HA/DR operations there is no guarantee of the systems used and therefore interoperability is not guaranteed.

One emerging constant in the Information Age, however, is the degree of user's familiarity with the common web interface of the World Wide Web, as well as the emerging use of web feeds. Additionally, web browsers are nearly guaranteed to be functioning on every computer system any organization may use to stay connected. To be agile in HA/DR operations, an information system should not only be web-enabled, but support the use of web feeds as well. Web-services, such as web feeds, provide the agility to integrate information between other organizations and their information systems.

Finally, in implementing a network-centric system, certain capability improvements should be observed in a force to:

- Improve Information Sharing
- Enhance the quality of information
- Increase shared situational awareness
- Enhance collaboration
- Enabled self-synchronization
- Enhanced sustainability
- Increase the speed of command
- Improve mission effectiveness[51]

These results could perhaps be used as measures of effectiveness for an implemented system, however, these improvements are more qualitative then quantitative, and would need to be further refined. As a baseline for a network-centric system, certain requirements can be derived from this qualitative list. In particular, such a system must support connecting edge users with relevant, accurate, and timely information, while additionally empowering them to be information contributors.

In summary, a network-centric system should be an open-standards, web-based system. Such a system would also need to support information flows that empower edge users to collaborate and self-synchronize, while providing a scale-free capability to passively share information quickly and efficiently with relevant users. This is the foundation for the Network-Centric Open Web Feed Architecture.

[51] The Implementation of Network-Centric Warfare: 43.

B. A NETWORK-CENTRIC OPEN-STANDARDS ARCHITECTURE (NCOWFA)

NCOWFA in an architectural framework for a system of systems approach to sharing information both internally and externally through DoD networks based on open web-based standards. In particular, NCOWFA is a conglomeration of emerging Internet, Web 2.0 constructs such as portals, blogs, wikis, and advanced file servers. These systems are interconnected through web feeds based on open-standards. These web feeds provide the capability for information to flow from one system to the next, to be shared horizontally and vertically, and to travel across the different domains and unintended organizations. The fundamentals of NCOWFA provide the framework to digitize and share information between disparate organizations and for organizations to be enabled to shift from a centralized hierarchical organization to a de-centralized edge-empowered organization. NCOWFA is capable of supporting such a shift because it is an open system that provides the capability to all users to post and smart pull. By empowering every user to be an information supplier and consumer, as well as providing each with the capability to then pull the information relevant to them dynamically, NCOWFA provides the capability to quickly and easily build scale-free, small-world, and fully connected information networks to complement current hierarchical structures, hastily formed networks of HA/DR operations, and the projected hybrid command and control network of the Information Age discussed in Chapter II.

1. A General Overview

This architecture is a conglomeration of current trends in the sharing of information on the Internet as of July 2006. NCOWFA is a shift from web-enabled systems to web-service enabled systems. Instead of designing systems to provide only web browser interfaces, an additional machine-to-machine interface is designed. This web feed interface is fairly easy to implement. This architecture is not the sole solution for solving every information sharing problem of the US government, but it provides a technological framework to complement such holistic solutions.

Although the technologies that are inherent in these systems make the generation and distribution of content and the useful description of the content far easier, the technical system will not be nearly as effective as it would with the people and processes

in place. There is no “cookie-cutter” technological solution for information sharing; this framework must be adapted to each individual organization or sub-groups of that organization. A paradigm shift would be expected to occur for even the most disparate user using systems based on this architecture, users would no longer search for information, but instead the information would come to them.

NCOWFA is not a bigger stove pipe, where a proprietary network and system is just encompassing more organizations. Instead, it is a system of information systems based upon open standards, which allows for multiple vendors and user organizations to build and adopt technologies around these standards and be guaranteed the ability to interoperate, to easily find and share information. The power of using open standards is the capability to share data quickly and effectively between disparate systems, allowing data to be dynamically formatted and changed to present different types of information. Additionally, open standards allow for change, the ability for different information subsystems to be interchangeable. This interchangeability provides a certain factor of future proofing, by allowing the different subsystems inside of the system to be upgraded or even replaced. One set of systems can be connected to another set of systems, easily integrating into a much broader system, that is far more interconnected than DoD networks are today. In general, the individual information subsystems can be grouped into one of two different types of systems: structure and content.

2. Core Components

NCOWFA is a framework to describe the building of a system of Web 2.0 constructs for sharing information. The core components of a single organization’s instantiation can consist of a tailored combination of portals, blogs, wikis, and advanced file servers, as well as other systems that support NCOWFA’s standards. Although they are represented as four separate systems, these systems could be separate applications installed on a single server or a server farm; this is all dependent on its scale of deployment. Additionally, the system to could be more simplified and combined into a single portal system. In terms of an information network, a single instantiation could be a single node or a network of interconnected systems, connected to a larger network. In essence, the hybrid Command and Control network referred to in Chapter II.

For simplicity, it is assumed one of each might be deployed in a generic organization, such as pictured in Figure 12. Although, the bare minimum would be one of these core systems, with the supporting capability of producing, and preferably reading web feeds, called syndication and aggregation.

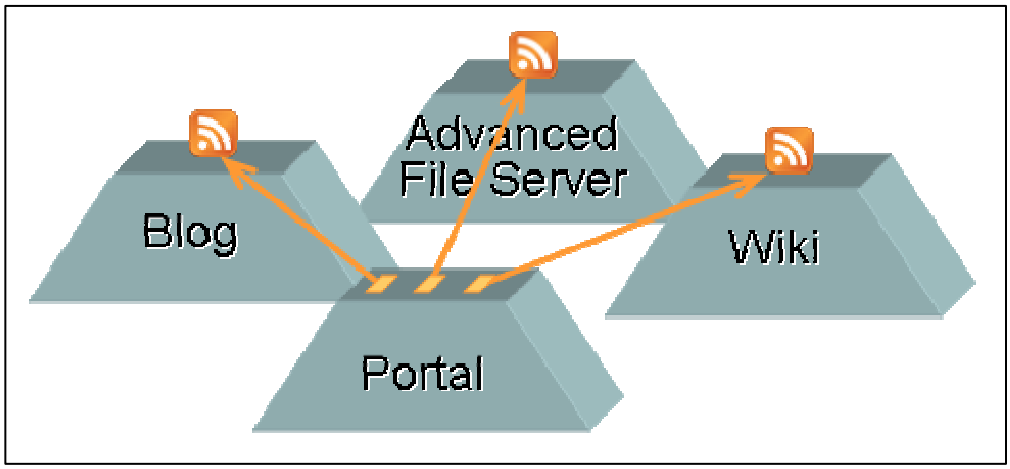

Figure 12. A Notional NCOWFA-based System.

In the case of Figure 12, the interconnection of the overarching system is fairly minimal, as portal users get current information from a blog, a wiki, and an advanced file server[52]. Even though it is represented as a single line, the orange arrow is a representation of the smart pull of information from multiple feeds in the content systems to multiple sources in the portal. This is a fairly typical installation to solve demands for a "portal" or content management system, because of its uncomplicated information flows and familiar pattern of a hierarchical structure. These systems are capable of being far more integrated allowing for the timely flow of relevant information into different areas of the system. The information flow of a more interconnected information network is depicted in Figure 13.

[52] In this paper, the term "advanced file server" is used to describe a file server conceptually more robust than a traditional file server. The characteristics of these types of systems are described in Chapter V.

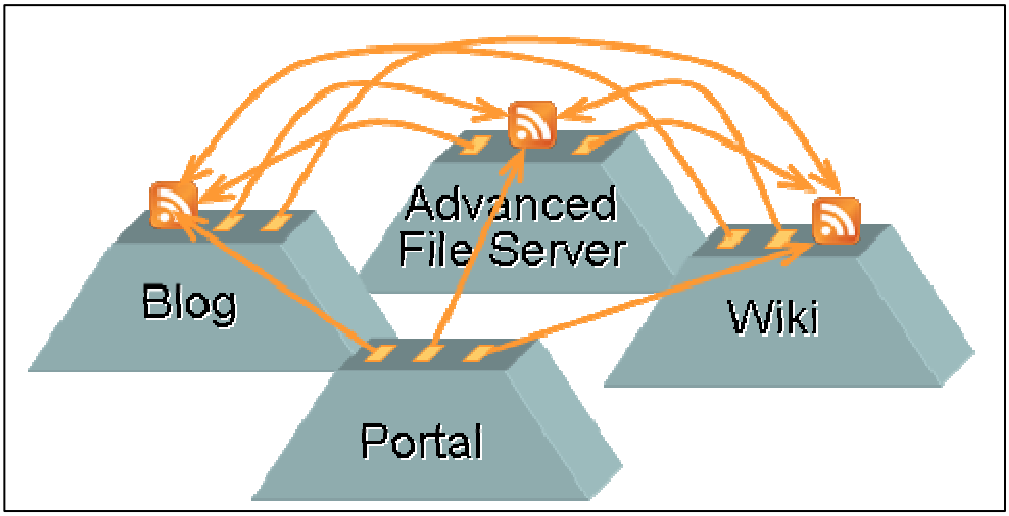

Figure 13. A Notional Interconnected NCOWFA-based System.

Looking closer, web feeds are the glue that interconnect the systems of this architecture and provide a means to mobilize information for sharing inside and outside an organization. The majority of current web feeds is based on open-standards and is a subset of the Extensible Markup Language (XML). Covered in depth in Chapter IV, these feeds are typically specially formatted webpages designed to be read by program instead of users. Due to these characteristics of a web feed, they are highly interoperable and customizable, allowing for a single user to have multiple personal feeds that can be read and displayed by a multitude of different systems.

Although there are many ways to read web feeds, the quintessential systems for reading web feeds are portals and more particularly user-customizable portals. These types of portals allow users to access a webpage that is customized to them. They can choose the formats and types of information they want displayed, like web feeds from other systems, and be able to access their "one-stop shop" anywhere on the computer network. A good analogy of these two systems is that they are the pipes and faucets of the system, providing the connections between systems and the interfaces for users to access the system.

If the web feeds and portals are the pipes and faucets, then all of the other systems can be seen as water sources. These systems are primarily used for digitizing information and documenting related metadata to that information. They provide the means and ways of putting data into the system and then categorizing and manipulating it to make the data

into information. These contributing systems can be integrated subsystems of portals or they can be their own stand-alone system. Portals and their content-providing derivations are covered in greater depth in Chapter V. They mainly consist of blogs, wikis, and advanced file servers.

The term blog is derived from the term “web log”, where users can maintain a log or diary. Blog applications are fairly similar to normal document editor, such as Microsoft Word, but are typically entirely web based, allowing users to directly edit and publish content as a webpage for any other authorized user to read. Blogs are typically written by a single user or a group of users each writing their own entry.

Wikis are similar to blogs, except content is written and edited by a community of users. Wikis are typically used to contain a “Community of Interest’s” body of knowledge, as they are written and maintained to provide current relevant summaries of information. Wikis differ from blogs and discussion boards in that they are voiced from a group into one chunk of information, instead of multiple chunks divided by each individual user and each of their entries.

Although, most content should be generated in more accessible formats, a majority of organizational knowledge is stored in computer files. Advanced file servers are away of sharing the information locked in those files by providing the capability to fully index the files for search, run automated processes on files, such as categorize by content, generate metadata, or convert formats. Additionally, advanced file servers, provide different interfaces such a shared network drive. Compared to the file repository of a simple shared network drive, however, these systems provide for space to automatically organize and categorize the files, and share them through web feeds.

3. Post and Smart Pull

The key network-centric power of NCOWFA is the capability for information to be posted by anyone and then pulled smartly by any other users. This notion of post and smart pull provides the capability for people to passively share information with people they do not know. The power of post and smart pull is captured by David Alberts and Richard Hayes in the book *Power to the Edge*:

> Thus, the move from smart push to post and smart pull not only solves previously intractable problems by identify important information and getting it to the right persons, but also facilitates the creation of the interoperability necessary to bring all relevant information and all relevant assets to bear.[53]

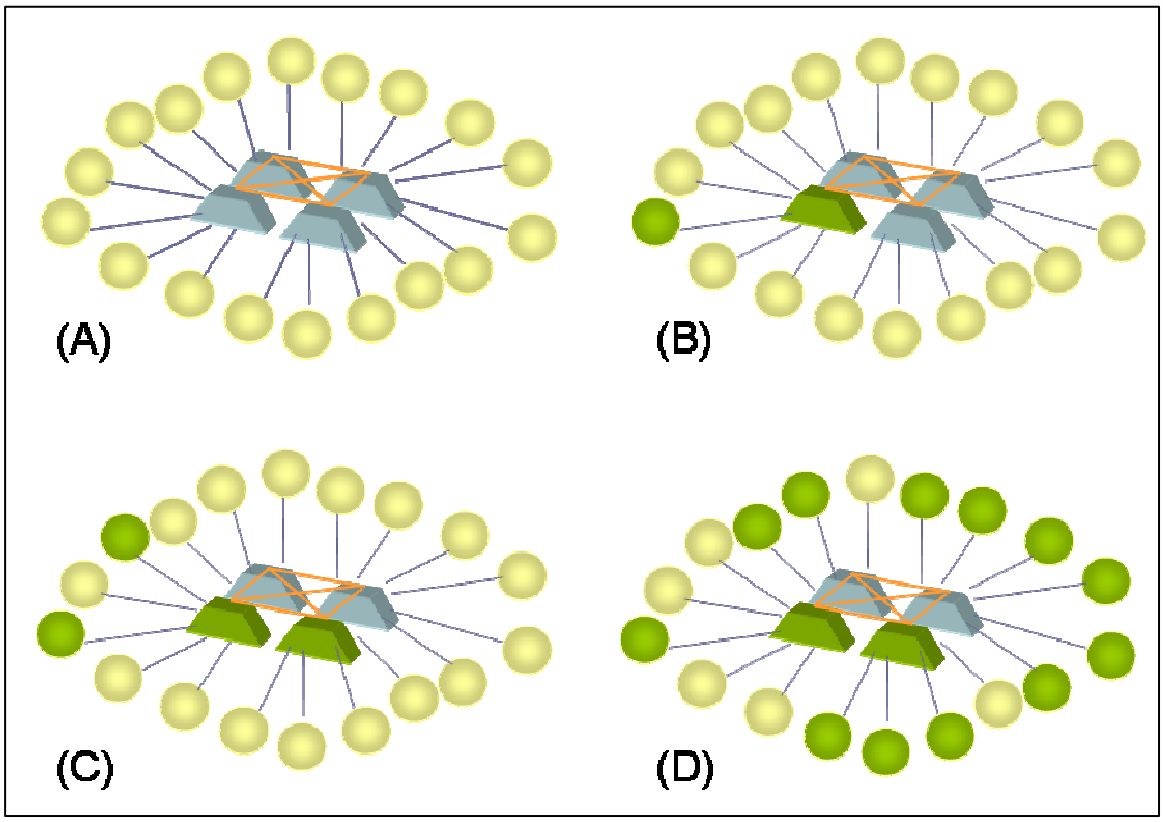

Figure 14. Information Flow in a NCOWFA Fully-Connected Network.

NCOWFA implements the concept of post and smart pull by using the different content generation systems to allow users multiple ways of digitizing their information. In examining Figure 14A, users (represented by yellow circles) are interconnected by means of NCOWFA-based system of systems. These systems may consist of a variety of systems that work together to allow for different ways to digitize and collaborate on information. Some examples of possible arrangements could be: a wiki used as a lessons learned repository, a system of blogs used for maintain different watch logs, a file repository to manage a command's files, and a portal to act as general web feed reader, or aggregator.

[53] David Alberts and Richard E. Hayes (2003): 120.

Focusing on how post and smart pull would be implemented, imagine a user posting information to a blog, where the information is symbolized by the color green, as illustrated in Figure 14B. As an example, the user is a watchstander on a ship conducting flight ops off the coast of an island in support of an HA/DR operation. The helicopter is bringing survivors to the ship for medical attention and bringing humanitarian aide back to shore. In this case, the watchstander logs in their watch's blog that a certain number of survivors were received and a palletized load of so many packets of food are on the way out. As illustrated in Figure 14C, down the passageway, the ship's Combat Cargo Officer is monitoring the watchstander's feed and updates the ship's offload/onload figures on his blog. Both of these blogs' feeds are consolidated into a ship's current operations feed, by the ship's portal and feed server. As illustrated in Figure 14D, the information is quickly spread to other personnel onboard. The feed is monitored by the ship's Commanding Officer, Executive Officer, Operations Officer, and Supply Officer from their offices or staterooms. The feed is also monitored by embarked staff, as well as other members of the crew, that want to know what is currently happening. All without asking any questions from the watchstander or having the watchstander personally contact them.

The flight information is also important to a number of other external organization, such as the Joint Task Force's (JTF) staff, the non-government organizations the ship is supporting on shore, the foreign government that is receiving the aide, as well as other government agencies that are supporting the relief effort. Figure 15 illustrates how this information can continue to flow outside of the ship to all of these other organizations, seamlessly in an efficient manner with interoperable standards that most of these organizations are probably already using. If these organizations do not have the software to support these standards, the JTF can simply give them open-source based, supportable software or direct them where to download it, without concerns of copyrights or licensing. NCOWFA brings interoperability and agility to these dynamic situations in sharing information, even with relevant, but unknown users.

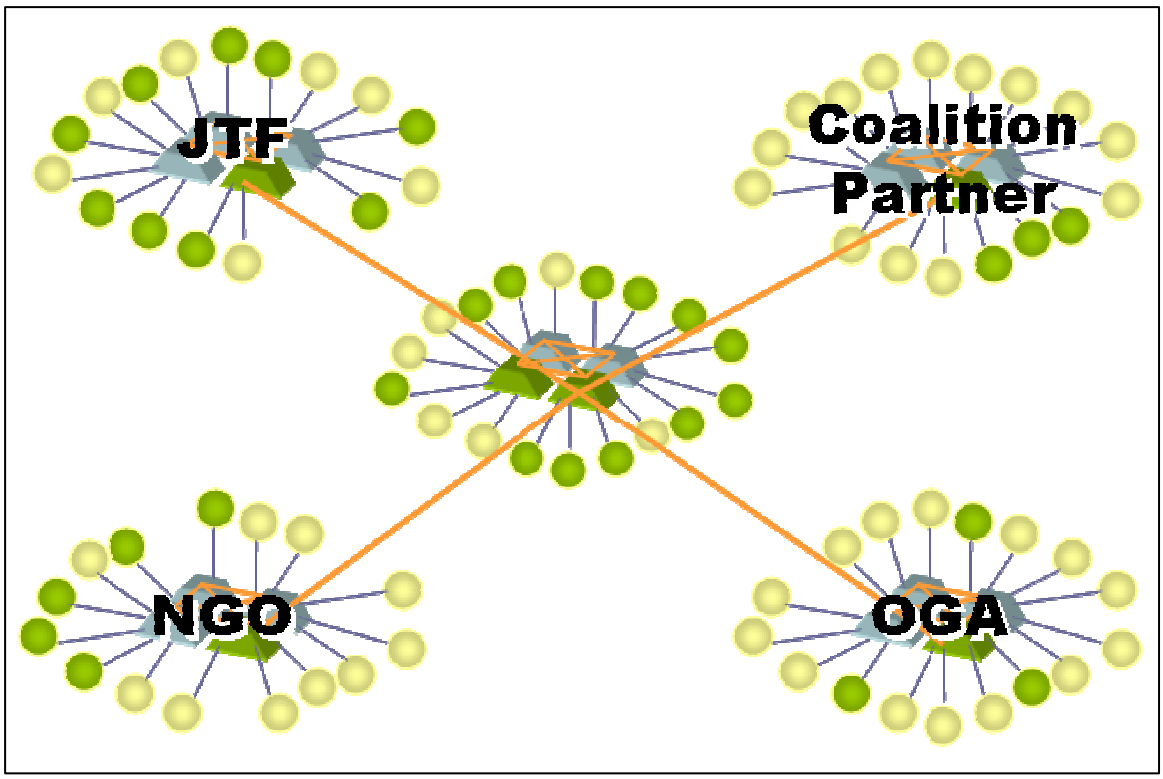

Figure 15. Information Flow in a NCOWFA Scale-Free Network.

C. POTENTIAL CURRENT MILITARY APPLICATIONS

With the Internet, there have been a number of a paradigm shifts. There was the shift from text based systems to graphical based systems. There was the shift from finding information through large directories to using indexing search engines. Now there is the shift from going to information to information coming to the user, the whole concept of smart pull. The US military is just beginning to start this most recent paradigm shift.

As the concepts of network-centricity materialize, the responsibility for making decisions will migrate up and migrate down in the organization, the organizations will flatten. Besides providing an answer to the more obvious generic question of sharing information, there are more potential current military applications of NCOWFA to consider.

1. Creating Network-Centric Organizations

There is a developing shift in how military organizations are beginning to problem solve. Traditionally, when a senior commander wants an answer to a particular

question, they would "staff it out," where the task will be assigned to an action officer and they will generate a brief to answer the question within a week or so. The brief will typically matriculate up the chain of command, with different levels adding their spin to the brief. Implementing command wide blogging, US Strategic Command (STRATCOM) has turned this method on its side. Initially only a few key personnel were blogging and majority of them where the commander's [General James Cartwright's] advisors. The more junior personnel were concerned in stepping out of the custom of following the chain of command to answer questions. The General's guidance was as follows:

> The metric is what the person has to contribute, not the person's rank, age, or level of experience. If they have the answer, I want the answer. When I post a question on my blog, I expect the person with the answer to post back. I do not expect the person with the answer to run it through you, your OIC, the branch chief, the exec, the Division Chief and then get the garbled answer back before he or she posts it for me. The Napoleonic Code and Netcentric Collaboration cannot exist in the same space and time. It's YOUR job to make sure I get my answers and then if they get it wrong or they could have got it righter, then you guide them toward a better way…but do not get in their way.[54]

Organizations that are embracing network-centricity are beginning to see the necessity to empower the edge user to give input. Although sometimes responses to the General's questions may only be 50-60% of a solution, they will usually be answered within minutes by anyone with a possible solution in his command.[55] This way of getting answers increases the possible solutions the commander might get, thus increases the options the commander has in making a decision. Imagine if the STRATCOM blogging system was enabled with web feeds to NCOWFA specifications. The General's questions would be able to quickly promulgate not only through his command, but through other commands as well. Depending on how the replies to the questions are being posted, perhaps as comments on the General's blog, users could then build off of each other, coming to a quicker consensus and developing more robust possible solutions.

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[54] Timmer. 2005. It's good to know leadership gets it . The daily brief., http://www.sgtstryker.com/index.php/archives/its-good-to-know-leadership-gets-it/ (accessed August 15, 2006).

[55] Gopal Ratnam. 2006. Blogging for solutions: StratCom's skiweb seeks answers beyond command structure. C4ISR: The Journal of Net-Centric Warfare 5, (7) (August): 34.

2. Content Staging

In terms of Information Age warfare, the effects on the outcome of a battle may have as much impact from the decisions that a Corporal makes as those made by the General in command. But how does the Corporal get the information that he needs to make the right decision? NCOWFA provides a framework for receiving that information. There are a number of data-generating organizations in the US military and supporting the US military. This data is collected and given to analyst to interpret and publish information to experts, who are able to then use their knowledge and act as advisors to the decision maker. But, if the decision maker is a Corporal, how many advisors is he going to have working for him? The Corporal needs to be knowledgeable, he needs to have knowledge of his environment, he needs to have knowledge of what could effect that environment, and he needs to have knowledge of what is working and what is not working. But how does he get that knowledge, he does not have the time for or access to a computer for that kind of research?

One way to bring the knowledge to the Corporal is to use an idea called content staging. Content staging is one of the ideas presented in a US Central Command (CENTCOM) Communication Directorate white paper of directorate future visions and current challenges. Content staging is a concept of meeting operational information sharing requirements for the "warfighter" in the "first tactical mile."[56] Content staging could be implemented with a NCOWFA-based system, where the information that the Corporal needs is smartly pulled for him electronically and presented in a way to quickly learn.

The advantage of using a NCOWFA-based system is the utilization of social computing. There are a number of other soldiers operating in the "first tactical mile," each with lessons learned that they could share and post on a wiki. The wiki would be editable by all, allowing for the users to help refine and construct a real-time idea board of what works and does not. The wiki could be updatable by a web browser or email. Each Corporal could setup custom web feeds based on keywords that would generate links to articles they are interested in. One might argue that if the Corporal does not know

[56] Susan Lawrence. 2006. Command, control, communications, computers (C4) white paper. 24 February 2006. US Central Command, J6, Tampa, FL.

what keywords to use, he will not get the information. This could be mitigated by providing additional feeds of the most popular and most recently updated information on the system. Additionally a visualization technique, called a tag cloud and presented in Chapter IV, could be used to show the fifty most popular keywords and their relative popularity. Such a system would be capable of including other soldiers coming to the area, they could also receive relevant information for future operations. Besides a lessons learned wiki, news reports, intel reports, and other relevant information could also be provided through web feeds. Blogs could be used for soldiers to post their individual experience, for analysts to publish their results, all of this too could be put into web feeds. These web feeds would then be viewed through a number of different methods, including perhaps even a daily one-page printout, providing a low-tech daily newspaper for the Corporal of some of the big pieces of information he should know.

3. Bandwidth Management

Web feeds could be used to help manage bandwidth. For example, if the Intelligence Officer on the staff of a Joint Task Force, wanted to make sure all of the Task Force's subordinate commands received a daily Intelligence brief from the staff, he would need to send a daily email to different personnel at each of the commands. If the brief was at all sizeable, the amount of bandwidth and storage space being used for these emails would grow quickly. If the Intelligence Officer was to setup a feed, the subordinate commands could monitor the feed. The subordinate commands would use web proxy servers that would cache the brief when someone downloaded it from the command, the brief would be available to the entire command, but only downloaded once. Continuing on this example, assume that the brief was not informative and most found it a waste of time, the subordinate commands would still know the brief is available, without needing to use the resources to download it, like they would if it was sent to them as an email.

Bandwidth usage could also be reduced, by selecting command popular web feeds from the Internet, downloading the related content, and hosting it locally. Internet access

could then be restricted to only key personnel, but popular daily content would still be available to all users.[57]

4. Cross Domain Information Sharing

There are a number of efforts in the US Government to improve sharing information between different agencies and organizations, a major impediment of this is mechanisms for cross domain information sharing, where data must past from one network to another. These networks usually have different classifications of the sensitivity of the information and information must be carefully moved from one network to another through special computer systems and operators. US Joint Force Command's (JFCOM) J9 Experimentation Directorate has made leaps and bounds in developing guards and other systems for supporting real-time information flows such as chat, as well as more persistent information flows, such as documents, in the Cross Domain Collaborative Information Environment (CDCIE).[58] Web feeds and advanced file servers could be used to help with this process.

For example, a Word Document that is marked SECRET has had all of the information pertaining to that classification removed. The user could upload the file to a special folder on the advanced file server for sending to an UNCLASSIFIED network. Once the file is uploaded a program, such as JFCOM's Security Enhanced Office Automation Suite, will be automatically executed to remove all of the known covert channels in the Word Document.[59] The file would then be automatically moved and put into a queue for review. The contents of folder for review could be listed with a web feed. The web feed could be monitored by a reviewer that would see the file in his queue, with a direct link to the file. The reviewer could review it and move it to a cleared for transfer folder. Another web feed could carry the contents of the transfer folder and either automatically or through an operator, move the files to the other network. On the other network, these files could then be put on another advanced file server that would crawl and index the files, generating keywords and other metadata for the files. The server

[57] John Stafford. 2004. The return of pointcast: Why the US military should immediately implementt RSS for information dissemination. Draft Topic Paper.

[58] Ed McLarney. 2006. Cross-domain collaborative information environment (CDCIE). Presentation June 12, 2006. US Joint Forces Command: Joint Concept Development & Experimentation (J9).

[59] Ibid.

could then hosts web feeds that would list different files dependent on the metadata or keyword searches users had applied for their personal web feeds.

5. Geo-Blogging

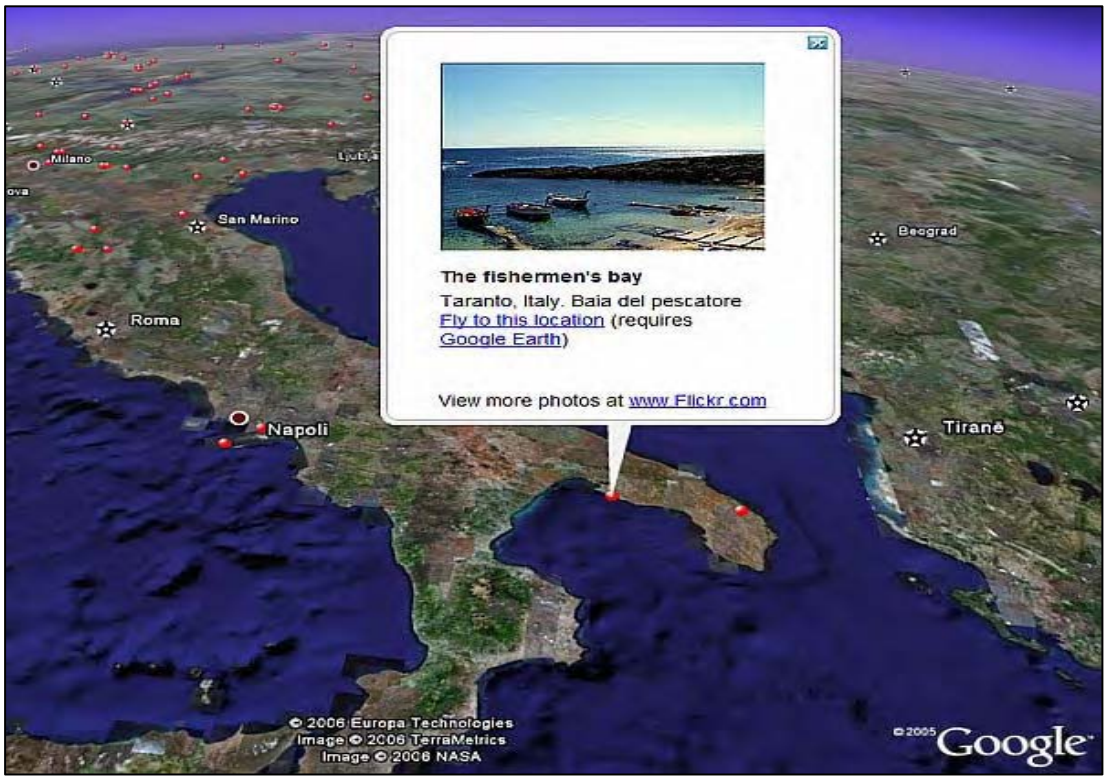

Figure 16. Example of a Geo-Blogging Mashup with Google Maps and Flickr.[60]

An emerging use of blogging systems is to allow users to email or text message posts to a blogging system with a phone. For example a user could geo-blog from their phone, where they take pictures of what they are seeing and upload those pictures with geo-tags, global position coordinates, and a short description of what they are seeing to their blog. This allows for other users to monitor their blog or more particular the blog's web feed. The web feed can be combined with other geo-blogger's feeds and be used to populate a mashup, combining the geo-blogged web feeds with a map. Other users could then be able to track the geo-bloggers on the map, seeing where they are in the world, what they are seeing, etc. This mashup could also generate additional web feeds relevant to certain locations, keywords, or results from running picture comparisons with services

[60] http://www.gearthblog.com/blog/archives/2006/08/two_flickr_phot.html (accessed August 13, 2006).

such as a Riya visual search engine.[61] In the end there is fairly little potential difference, between blue force tracking and geo-blogging, except it is completed through the use of an NCOWFA-based system, allowing tracking information deemed shareable to be easily shared with coalition forces and organizational partners. Inversely, geo-blogging could be used as a white force tracker for tracking members of non-government organizations, who sometimes prefer to not work with military forces, however, may be open to blogging and geo-boggling from their public affairs perspective.

6. User-Defined Operating Pictures (UDOP)

One of the capabilities of customizable portals is to allow users to tailor the system to their individual informational needs, to organize feeds in a way that is intuitive for them to take in. Portals facilitate User Defined Operating Pictures (UDOP). UDOPs are a customization of Common Operating Pictures (COP), which is away of providing shared situational awareness with a map based blue and red force tracking system. This information, however, is not always enough to give a user good situational awareness and they will typically require other information that is relevant to their needs.

Since the information in portals is displayed on webpages, the formatting and presentation of the information can be easily changed to fit different needs. For instance one user could setup a page to display a one to two page summary of information to know for the day and print it out. Another user could have a portal webpage setup to be displayed on a wall mounted screen, such that they could have a mini-knowledge wall that is updated every couple of minutes with the latest information, providing a customized shared situational awareness in relation to the categories of information the user is interested in.

7. Group Collaboration

One of the strengths of a NCOWFA-based system is its capacity for facilitating passive, persistent communications. Although there are a number of different forms of instant communications, such as chat and voice communications, there are only few that allow for geographically dispersed, time delayed communication, mainly email. One of the shortcomings of email, is its lack of the ability to share information with people who

[61] http://www.riya.com/ (accessed August 13, 2006).

the sender does not know. Although email allows for group collaboration in a passive, persistent capacity, it remains inclusive, and unable to allow for users with a need to know, but unable to be shared with. Alternatively, using a wiki for a group collaboration server can offer both the passive, persistent capacity of communication, while allowing other potential contributors access to the project. This notion of unintended user from other organizations, is a trademark of an Information Age organization. The features and functions of a wiki can vary from system to system, but the key defining capability is that all users can edit content.

This notion of groups of users being able to edit pages can have many useful military applications. The most directly researched is the concept of a SmartCOP, where a wiki is combined with a COP, allowing for any user to add information about a track in a force tracking system.[62] Another potential application for a wiki is to use one for a Lessons Learned repository, or any community's body of knowledge for that matter, allowing personnel to enter their lessons learned into the system, with other users reading, editing, and adding their input to the lessons learned system. The Lessons Learned wiki could then be used as a training and preparation aid for follow-on forces or future operations. Additionally, wikis can support more dynamic group collaboration as well, such as a staff message and brief writing system. Large organizational messages, such as Commander's Daily Intentions, Air Task Orders, or OPORDERS, could be written without the infamous "another user is editing lockout." Taking advantage of a technology called S5, which formats a webpage and web browser to act as a presentation system.[63] Briefs can be written up to the brief, without the need to have a coordinator to consolidate it. Additionally, since S5 uses webpages, a brief could even be generated live in a real-time, on the moments notice. This would enable the Commander to be briefed with up-to-date information, instead of the usual two to three hour time late. Of course

[62] Lee Whitt. 2005. SmartCOP - the fusion of collaborative workspaces and the common operational picture. Paper presented at 10th International Command and Control Research and Technology Symposium, The Ritz-Carlton Tysons Corner, McLean, VA.

[63] S5 stands for Simple Standards-based Slide Show System. It is a web page format specification, developed by Eric Meyers, that allows a web browser to display properly tagged web pages as a slide presentation. For more information reference the standard's homepage at http://meyerweb.com/eric/tools/s5/ (accessed August 13, 2006).

this also means that presenters will be on the spot for being able to respond to an operational changes.

D. AN EXAMPLE: FUSING INFORMATION

While visiting one of the FLEET Staff Watch Centers, I watched their Staff Watch Officer in action. The watch officer was receiving emails and message traffic quicker than he could read them; additionally he was trying to monitor the conversations occurring in several different chat rooms and reports being generated by several of his subordinates. Additionally, he was tasked to monitor the news for current developments in covering a recent coalition operation. To properly document the watch, the watch officer had to write an Operation Summary (OPSUM) Report in Microsoft Word, prepare an accompanying brief on the same information in Microsoft PowerPoint, which he was also noting in his paper-based watch log. Due to the size of the OPSUM report and brief, the watch officer would also write a Watch Officer's Turnover Log to be emailed with the OPSUM to a list of about 30 personnel, so the command's leadership were up to date with current operations and what would be manually posted on the command's webpage in an hour by the command's webmaster.

What if there was an easier way to do this? What if the Watch Officer could monitor incoming feeds of information from all of these sources, feeds that he could selectively add to a web based log that can dynamically display the current operations as a document, a presentation, or a feed for someone else to monitor and stay up-to-date? A NCOWFA-based system could probably resolve some of these issues of the watch officer's work of fusing information from different sources and then redistributing them, to keep his staff informed. Additionally, his work would then be better organized and digitized to flow other organizations.

1. Brute Force

Undoubtedly, the watch officer was using an approach easily described as a brute force method, a method in computer science of systematically enumerating through every single element of a group, regardless of the likelihood or relativity of that element to your desired result. In other words, the watch officer was forced to read every single email, message, chat conversation, and news headline in a near linear fashion, to make sure he was maintaining situational awareness. There were a number of factors occurring in this

situation, mainly information overload. Arguably a good watch officer would be able to maintain situational awareness with this method in particular circumstances, however there is a large amount of superfluous information that he did not need to receive, thus requiring him to expend time and mental resources on, because there was no organization or customization to his method. At some point there could be too much information for the watch officer to process in this method. Traditionally, the natural solution to such a problem would be to assign an additional subordinate or assistant watch officer to help, however, this is ignoring the original ideas espoused with network-centricity.

With the growth of fusion centers, the situation in this example is probably becoming more and more common. In the current situation, the watch center was well funded, and the watch officer may have had a view similar to that of Figure 17.

Figure 17. A Watch Officer's Desktop Using an Eight Screen Monitor Array.[64]

As can be seen by the figure, information is disjointed. Although the watch officer is presumably capable of processing a large amount of information, there is also a large amount of redundancy, as exemplified by the number of screens his reports and briefs are taking up, the watch officer is probably copying information from one report to the other, to the brief, and undoubtedly also entering the same information in a green logbook. In this case, the watch officer is re-entering the same information four separate times!

[64] After: http://www.digitaltigers.com/zenview-atlas19s.shtml (accessed: July 6, 2006).

Perhaps the watch officer's processes could be simplified with an information system such as a blog.

2. Digitizing Information

Blogs are covered in greater depth in Chapter V, however, generally speaking the watch officer could enter the information they were going to report in the logbook, the Turnover Log, the Operational Summary Report, and the Operational Summary Brief in a blog. As the watch officer enters the information, he also "tags" it, or labels it with meta-data. Some metadata is automatically entered, such as a time stamp and author's name, and perhaps digitally signed as well. The watch officer will also classify the information, perhaps categorize it, but most importantly label to what level this information should be promulgated. Should it be simply noted in the log, or also included as a turnover item, noted in the OPSUM Report, as a briefing bullet in the OPSUM Brief, or perhaps as critical for immediate distribution. Although this is adding some additional process to the watch officer's work, it is organizing the information he is putting into the system as a whole. No longer will his information be locked up in an electronic file saved on a inaccessible file server or "shot-gunned" out through a mass email, either way requiring countless recipients to also use a brute force method in receiving that information. Since the information is now organized and categorized, the information is mobile; it can be dynamically pulled through web feeds.

3. Working with Critical Information Flows

Take for an example a critical piece of information that needs be disseminated as quickly as possible to the command's leadership, such as a Commander's Critical Information Requirement (CCIR). Arguably, the watch officer can use a telephone and start calling people, but the list of people to call can grow exponentially, additionally, this is a linear system of disseminating that critical piece of information, the watch officer would once again be using a brute force method of working through the list of contacting different people, of explaining the information to each individual before the next. Another option is to send a mass email to all the critical personnel, but then the information will not reach the recipients until they check their email and read through their list of emails. If the command was using web feeds on the other hand, the watch

officer is able to use the power of a network to contact the critical personnel, they are able to be contacted in parallel, or at the same time.

One of the web feeds the watch officer could be feeding would be a CCIR feed, perhaps called the CCIR Feed. The CCIR Feed could be monitored by multiple web feed compliant systems, to quickly disseminate the information. For example, one program could send voice messages or emails to the phones of the critical personnel. Another program could display a message on a person's computers or send an instant message to different tactical chat rooms. A portal or feed reader could be displayed on a large flat panel on the wall of key personnel's offices or in the command's hallways. The CCIR Feed could also be monitored by the command's superiors' watch officer and the command's subordinate watch officer, informing these commands at the same time about the critical information. Perhaps, if the CCIR is related to a specific geographic location or mission, a feed could be generated by a feed server that could monitor CCIR, as well as, other similar feeds and generate a consolidated critical feed relevant to the location or mission, which can then be used to keep the relevant personnel informed.

4. Monitoring Information

The watch officer's system could be further simplified by modifying the way he monitors news from the media. The media industry has begun to take advantage of web feeds and provide an assortment of different feeds, such as breaking news. Additionally, some Internet news companies, such as Google News, provide the capability to generate web feeds from keyword searches of the news feeds that they monitor. Arguably, if the watch officer has access to the Internet, then he can generate news feeds through Google News for the key stories he is monitoring for, as well as, monitor all of the other news agencies' feeds. In essence, the watch officer is then monitoring more relevant information from the media without the need to constantly "watch" the news.

A similar method to monitoring the news media could be used for monitoring message traffic. Currently, message traffic is typically transmitted at different commands locally through email, either emailed directly to individuals or hosted in a shared folder, where every user is expected to read through every message. This method could be changed so that instead all of the messages are emailed directly to a web feed server. The messages can then be hosted by the server without effecting the storage and performance

of the mail servers. The messages can also then be categorized based on date-time-groups, the sender, the recipients, the subject line, the classification, and keywords in the message. Users can search the archive of messages for references of past messages and also subscribe to generic feeds or custom feeds based on keyword searches to receive new messages. Even if the watch officer must read every message, he can then go through and mark relevant messages through his blog and generate a feed of relevant messages, such as those that would be posted on a read board for personnel to read. The feed server can also allow for other members of the command to mark and comment on messages, similar to a forum or discussion board, facilitating personnel to more efficiently share messages without filling other personnel's email inboxes.

E. SUMMARY

This chapter provided a diverse set of examples to show the CONOPS for a network-centric open-standards web-based architecture. It was intended that the reader would be able to have a high level understanding of how different emerging Internet technologies could be used to develop a network-centric environment. In particular, it is hoped that the reader will have an understanding of the importance of open-standards for robust system interoperability and the applicability of web feeds for providing agile information sharing through out the DoD both internally and externally.

Chapter IV and V will be provide a further technical description of the different notional components of a NCOWFA-based system.

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IV. A SYSTEM FOR LINKING INFORMATION FLOWS

A. WEB FEED BASICS

A web feed is the syndication of the content on a web site. A web feed is a document typically written in Extensible Markup Language (XML) and usually transported using the Hypertext Transport Protocol (HTTP). In other words, a web feed is a webpage that is designed to be read by a software program versus a person over the World Wide Web. Software programs used to read web feeds are called aggregators. Aggregators will usually check the web feed's timestamp for change at a determined time interval, from once a minute to once a week. Once an update is detected the aggregator will download the page and process it.

B. HOW WEB FEEDS WORK

Web feeds are the network. The original power of the World Wide Web was the ability to hyperlink, or embed a link, to another webpage inside of a webpage. Web feeds are the next evolution in hyperlinks. Instead of linking a webpage to another webpage, an entire website can be linked to another website. The information flow of following links is far more automated with web feeds, instead of a user manually clicking on links and "connecting the dots" from one webpage to another, the user is provided with more current and relevant links than that were potentially at the end of the connection.

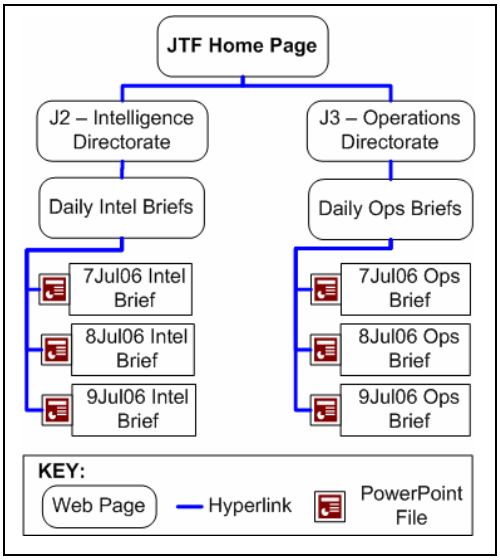

Figure 18. A Basic JTF Command Website.

For example, Figure 18 shows the information flow of hyperlinked webpages. In this example, a Joint Task Force (JTF) has a command webpage that hosts daily briefs. In particular, the Daily Intelligence (Intel) Brief and Daily Operations (Ops) Briefs are posted under their respective directorate web sites. To get to a brief, a user would need to follow the hyperlinks (represented by the blue lines) and at each webpage selecting the next link and downloading the content for the webpage.

To illustrate this point, to get the 9Jul06 Intel Brief, the user would need to connect to the JTF Home Page, the J2 webpage, the Daily Intel Briefs webpage, and then finally, if the brief is posted, select the brief and download it. Arguably, an experienced user could note the address for the Daily Intel Briefs webpage and simply check that webpage regularly for updates, but that still takes time and bandwidth if while checking for the brief a web proxy server is not caching the requests or conducting a conditional GET command, downloading the webpage only when the page has been updated.

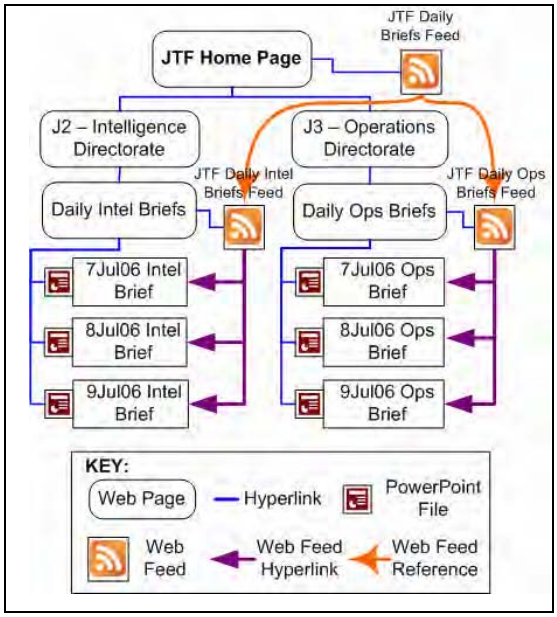

Figure 19. A Basic JTF Command Website with Web Feeds.

Figure 19, is an example of the same basic website presented in Figure 10 with the addition of web feeds. The orange square with the dot and extending lines is the universal symbol for a web feed. In the case of this example, the website has three feeds. One feed is a list of the past couple of Daily Intel Briefs in chronological order based on

the last time the file was added. Another feed is similar to the first, except it is a list of the past couple of Daily Ops Briefs. The purple colored Web Feed Hyperlink is the embedded link for each item in the feed back to the file on the JTF website. The third feed, the JTF Daily Briefs Feed is a feed generated by the combining of the first two feeds and taking the most recent element of each feed.

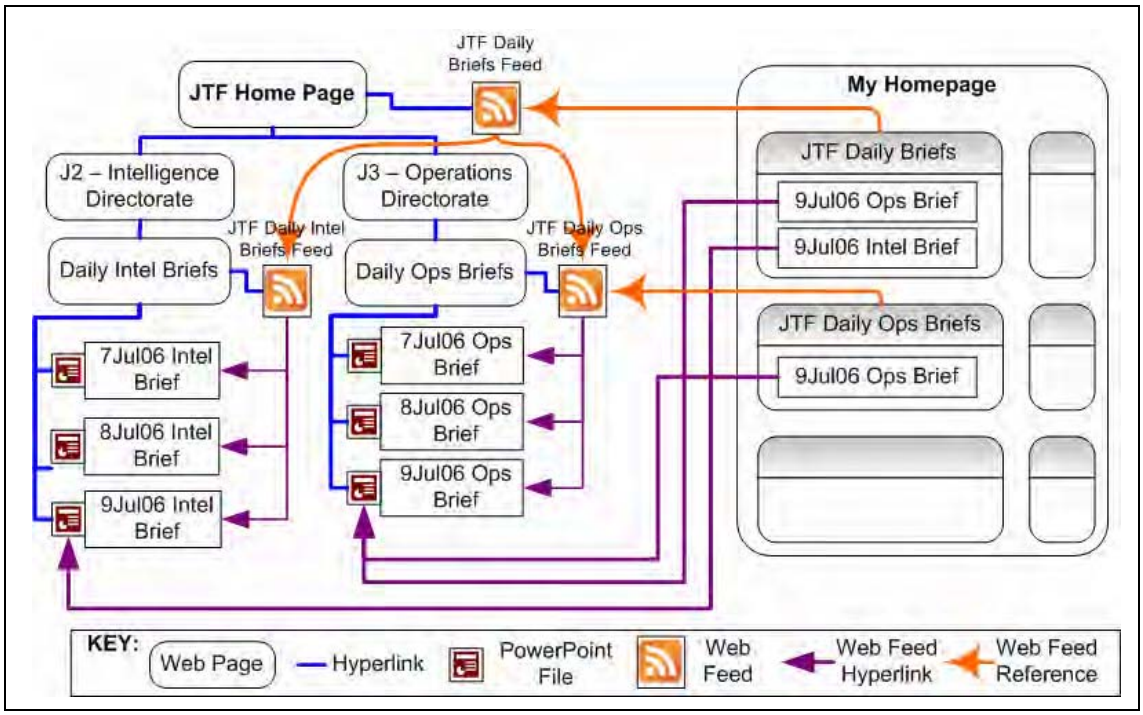

Figure 20. The Web Feed Information Flow for a Basic JTF Command Website.

The three web feeds now available through the JTF website will allow anyone interested and with access to the website to stay up to date using an aggregator to check the site for updates. As illustrated in Figure 20, a user would only need to log into an aggregator that will check the website for the latest brief and display a description and a link directly to the brief. There is no need to spend the time searching the JTF's website for the latest brief or use precious bandwidth to download unneeded webpages. The information was automatically pulled for the user and presented in an easy to use format.

If the servicing of these feeds were to become too great for the JTF server's resources, the feeds can also be hosted through a proxy server, which would copy the feed once every ten minutes or so and keep a cache of the feeds for web feed servicing. This method could also be used with low bandwidth commands, such as those located on

ships. The feeds and the links they reference could be checked by a high bandwidth proxy that would copy them locally when updated and host them to respond to requests from outside of the command.

C. RSS AND ATOM: SPECIFICATIONS

1. A Short History of Web Feeds

The concept of web feeds was introduced in 1997 as a Wired Magazine introduced the concept with a cover story.[65] There were a number of different standards proposed over the next couple of years, but RSS, currently the most common web feed format, was properly introduced by Netscape in 1999 for use with their user-customizable portal, MyNetscape.[66] Although there is some argument over what the acronym, RSS, stands for, the RSS 2.0.1 specification spells it out as an acronym for Really Simple Syndication.[67] RSS has also been described as Resource Description Framework (RDF) Site Summary by the RSS 0.9 and 1.0 specifications and described as and Rich Site Summary in the RSS 0.91 specification.[68]

Historically speaking, there have been several problems with the adoption of web feeds. One of the main stumbling blocks with adoption was that different groups were developing the specification. As is apparent by even the inconsistency of name, these groups did not work well together. Additionally, was the issue of the lack of availability, there were only a few feeds for users to read, so there were a limited number of users. Of course, since there were a limited number of users there were only a few feeds. RSS suffered a rather circular problem; similar to a discussion of whether the chicken or the egg came first, which was only made worse by a lack of specification consistency. This type of chicken and egg problem is arguably causing the same difficulty of adoption on DoD networks.

In the terms of the Internet, two factors could be pointed to in how RSS overcame its earlier stagnation: the popularity of blogs and the solidification of the specification. On July 15, 2003, Dave Winer froze the development of his RSS work and released RSS

[65] Kevin Kelly and Gary Wolf. 1997. Kiss your browser goodbye: The radical future of media beyond the web. Wired 5, (3) (Mar): Cover.

[66] http://www.internetnews.com/infra/article.php/3612561 (accessed June 10, 2006).

[67] http://blogs.law.harvard.edu/tech/rss (accessed July 16, 2006).

68 http://goatee.net/2003/rss-history.html (accessed July 16, 2006).

2.0.1 through Harvard University under a Creative Commons License to help foster the adoption by providing an unchanging specification. Under the license, there was to be no more expansion to the RSS specification only clarification, with the one caveat that only elements described in a namespaces could be used. [69] With their popularity as a tool in the 2004 US Presidential Elections, the usage of blogs exploded with a growth of 58% and RSS feeds followed with a total of six million American users using aggregators to read feeds by the end of 2004.[70]

With the RSS specification set in stone, the only extensions for syndication would be through namespaces or through separate web feed specifications. One of the resulting separate specifications was Atom. Atom was started in 2003 with the goal of being "100% vendor neutral, implemented by everybody, freely extensible by anybody, and cleanly and thoroughly specified."[71] Atom was created through the work of an online community using a wiki. The Atom 1.0 specification has been issued as a proposed standard through an international standards body, Internet Engineering Task Force (IETF), with RFC 4287 in December 2005.[72] The complementing Internet-draft protocol was published on June 23, 2006 and will expire December 25, 2006 for publication.[73] I would expect to be completed by the end of 2006, however, with the RFC officially published, the standard is available to be adopted.

2. Comparing RSS and Atom Web Feeds

Currently, the two most commonly used web feed specifications used on the Internet are RSS 2.0.1 and Atom 1.0. RSS has become synonymous with web feeds and is typically used by advertisers to describe both, treating ATOM feeds as another variation of RSS that they support. With ATOM becoming a full open standard, this will probably change with the standard moniker shifting to some variation of the term web feeds. Under the RSS vernacular web feeds are referred to as channels, with Atom they are referred to as feeds. In both cases these feeds are populated by two types of data:

[69] http://blogs.law.harvard.edu/tech/rssVersionHistory (accessed July 16, 2006).

[70] Lee Rainie. 2005. The state of blogging. Pew Internet & American Life Project, 202-419-4500, http://www.pewinternet.org/pdfs/PIP_blogging_data.pdf (accessed July 17, 2006).

[71] http://www.intertwingly.net/wiki/pie/RoadMap (accessed July 19, 2006).

[72] http://www.ietf.org/rfc/rfc4287.txt (accessed July 19, 2006).

[73] http://www.ietf.org/internet-drafts/draft-ietf-atompub-protocol-09.txt (accessed July 19, 2006).

metadata describing the feed and an array of information elements the feed is syndicating. These elements are either called items under RSS or called entries under Atom. Table 1 compares the relevant components of the two web feeds. Similarly, Table 2 does the same with the different relevant components of the two types of feed elements. In the case of both tables, those components that are bold are required components; all other components are optional with some caveats.

Table 1. A Comparison of the Relevant Components of RSS and Atom Feeds.

RSS 2.0 (Channel)	Atom 1.0 (Feed)	Description
	id	A universally unique and permanent URI
title	**title**	The title of the feed
lastBuildDate	**updated**	The timestamp the feed was modified
description	subtitle	A description of the feed
link	link	RSS: The URL to the corresponding website, ATOM: A related web page
category	category	One or more categories the feed belongs to
managingEditor	author or contributor	Email address relating to content
webMaster		Email address for technical issues
language	xml:lang	The language the feed is in
copyright	rights	Copyright information
generator	generator	The system used to make the feed
ttl		The number of minutes a feed should be cached before refreshing
image	logo	The URL for an image representing the feed
	icon	A smaller version of logo
skipHours		Suggested hours the aggregator can skip the feed
skipDays		Suggested days the aggregator can skip the feed

Table 2. A Comparison of the Relevant Components of the Elements of RSS and Atom Feeds.

RSS 2.0 (Item)	Atom 1.0 (Entry)	Description
guid	**id**	A unique identifier for the element
title	**title**	The title of the element
	updated	The timestamp ofthe last time the element was modified
description	summary	A description of the element
link	content	A URL to the item or the complete content of the element
author	author or contributor	The author of the element
category	category	One or more categories the element belongs to
	link	A related webpage
comments		A URL to a comments relating to the element
source	source	The original feed the element came from. Particularly, if copied from another feed.

3. Examples of RSS and Atom Web Feeds

To better explain how the two different feeds would be formatted and to more easily compare the difference. Figure 21 and 22 are examples of the JTF Daily Briefs Feed presented earlier and illustrated in Figure 20. As a by product of both specifications being XML 1.0 subsets, it can be seen by comparing the two figures, the feeds are rather similar in formatting and both formats can usually be easily supported by most aggregators, since most aggregators are using XML-parsers to extrapolate the data.

```
<?xml version="1.0" encoding="utf-8"?>
<rss version="2.0">
   <channel>
      <title>JTF Daily Briefs</title>
      <description>The most recently available daily briefs generated
                   by the JTF.</description>
      <link>http://www.jtf.mil/</link>
      <lastBuildDate>Sun, 9 Jul 2006 18:30:02 GMT</lastBuildDate>
      <managingEditor>j6@jtf.mil (CAPT John Doe)</managingEditor>
      <category>Daily Briefs</category>
      <category>Classification: Unclassified</category>
      <item>
         <title>9Jul06 Ops Brief</title>
         <link>http://www.jtf.mil/j3/briefs/9Jul06-J3Brief.ppt</link>
         <pubDate> Sun, 9 Jul 2006 18:30:02 GMT</pubDate>
         <source url="http://www.jtf.mil/j3/DailyOpsBriefs.xml">JTF
                Daily Ops Briefs</source>
         <category>J3</category>
         <category>Classification: Unclassified</category>
      </item>
      <item>
         <title>9Jul06 Intel Brief</title>
         <link>http://www.jtf.mil/j2/briefs/9Jul06-J2Brief.ppt</link>
         <pubDate> Sun, 9 Jul 2006 13:23:02 GMT</pubDate>
         <source url="http://www.jtf.mil/j2/DailyIntelBriefs.xml">JTF
                Daily Intel Briefs</source>
         <category>J2</category>
         <category>Classification: Unclassified</category>
      </item>
   </channel>
</rss>
```

Figure 21. An Example of an RSS 2.0.1 Compliant Web Feed

In examining the two figures, it is important to point out the relevant metadata that is included with the links. Both of the syndication formats provide an easy way to summarize each element of information. The additional metadata provided with the feeds and feed elements, provide additional opportunities for information management and passive communications. With the capabilities to embed multiple category descriptions, it is apparent how easy it is to include the overall classification of the feeds and their

elements or other any other descriptive information. This could be exploited further by using the XML Namespaces DoD is developing, to describe different components of the feeds or elements, for example a Classification component. However, an XML Namespace is a universal description that DoD must develop holistically to realize network-centricity.

```
<?xml version="1.0" encoding="utf-8"?>
<feed xmlns="http://www.w3.org/2005/Atom">

   <title>JTF Daily Briefs</title>
   <subtitle> The most recently available daily briefs generated
by the JTF.</subtitle>
   <link href="http://www.jtf.mil/DailyBriefs.xml"/>
   <updated>2006-7-09T18:30:02Z</updated>
   <author>
      <name>CAPT John Doe</name><email>j6@jtf.mil</email>
   </author>
   <id>http://www.jtf.mil/</id>
   <entry>
      <title>9Jul06 Ops Brief</title>
      <link href=”http://www.jtf.mil/j3/briefs/9Jul06-J3Brief.ppt”/>
      <id> http://www.jtf.mil/j3/briefs/9Jul06-J3Brief.ppt </id>
      <updated>2006-7-09T18:30:02Z</updated>
      <category term=”J3”/>
      <category term=”Classification: Unclassified”/>
      <source>
         <id> http://www.jtf.mil/j3/DailyOpsBriefs.xml</id>
         <title>JTF Daily Ops Briefs</title>
         <updated>2006-7-09T18:30:02Z</updated>
         <author>
            <name>CAPT John Jones</name><email>j3@jtf.mil</email>
         </author>
      </source>
   </entry>
   <entry>
      <title>9Jul06 Intel Brief</title>
      <link href=”http://www.jtf.mil/j2/briefs/9Jul06-J2Brief.ppt”/>
      <id> http://www.jtf.mil/j2/briefs/9Jul06-J2Brief.ppt </id>
      <updated>2006-7-09T13:23:02Z</updated>
      <category term=”J2”/>
      <category term=”Classification: Unclassified”/>
      <source>
         <id> http://www.jtf.mil/j2/DailyIntelBriefs.xml</id>
         <title>JTF Daily Intel Briefs</title>
         <updated>2006-7-09T13:23:02Z</updated>
         <author>
            <name>CAPT Bill Smith</name><email>j2@jtf.mil</email>
         </author>
      </source>
   </entry>
</feed>
```

Figure 22. An Example of an Atom 1.0 Compliant Web Feed

E. TRENDS

With the continued growth of RSS feeds and coming approval of the ATOM syndication standard, web feeds have reached their tipping point on the Internet. Their popularity are fueling a number of interesting trends, the most relevant are the different forms aggregators are taking, the integration of web feeds into other systems, the visualization of feeds, and the continued extensions of web feed specifications.

1. Aggregators

As a side effect of web feed popularity, the diversity of aggregators has also increased. Initially, an aggregator was a webpage that would read feeds and dynamically populate the webpage's content with feeds. This method is still well used and has developed into user customizable web based desktops such as is the example of Figure 23. All of the different boxes on the webpages are feeds from different sources, giving users an up-to-date customized view of the world.

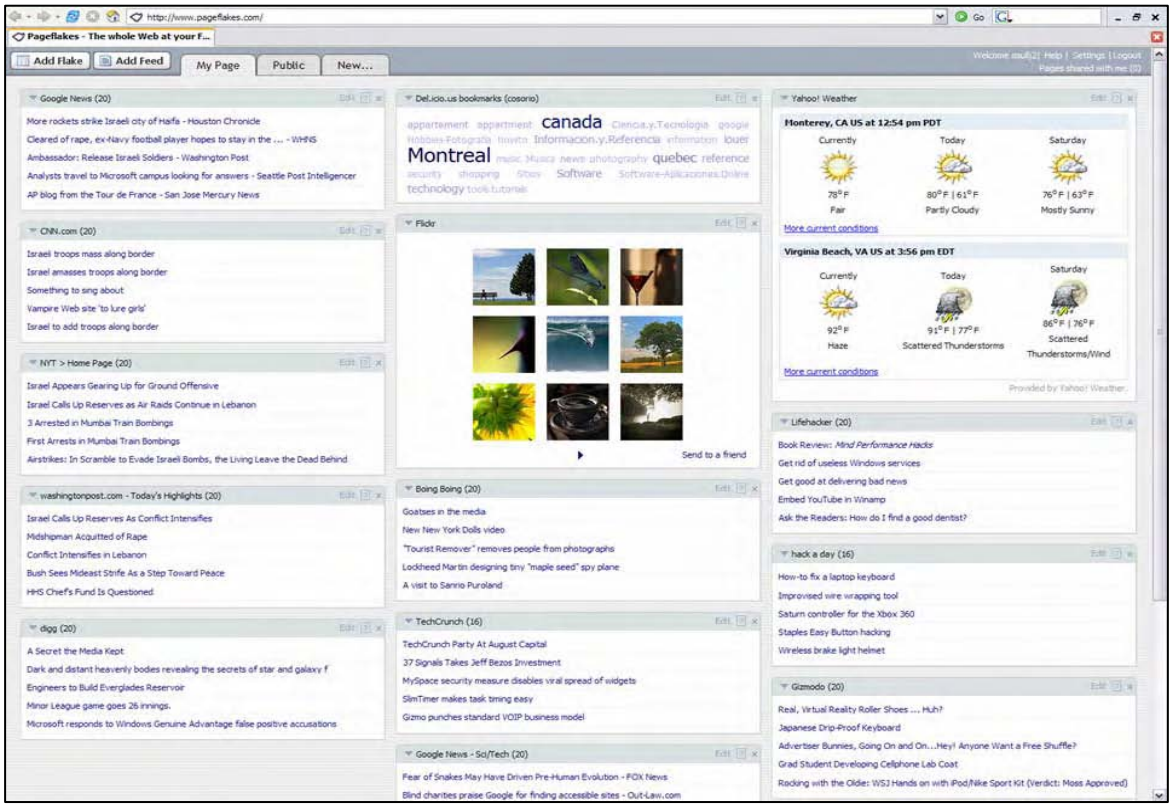

Figure 23. Example of a User-Customizable Web-Based Desktop Portal.[74]

[74] http://www.pageflakes.com (accessed July 21, 2006).

In addition to online aggregators, offline aggregators were developed to combat the "click and wait" of the typical dial-up connections that were eventually fixed by broadband Internet service providers. The capabilities of offline aggregators are still well desired by power users and so aggregators have moved from web pages to be integrated with web browsers, other desktop applications, and operating systems. Figure 24 is an example of an integration of a web feed reader, using an add-on program to have Microsoft Outlook read RSS feeds.

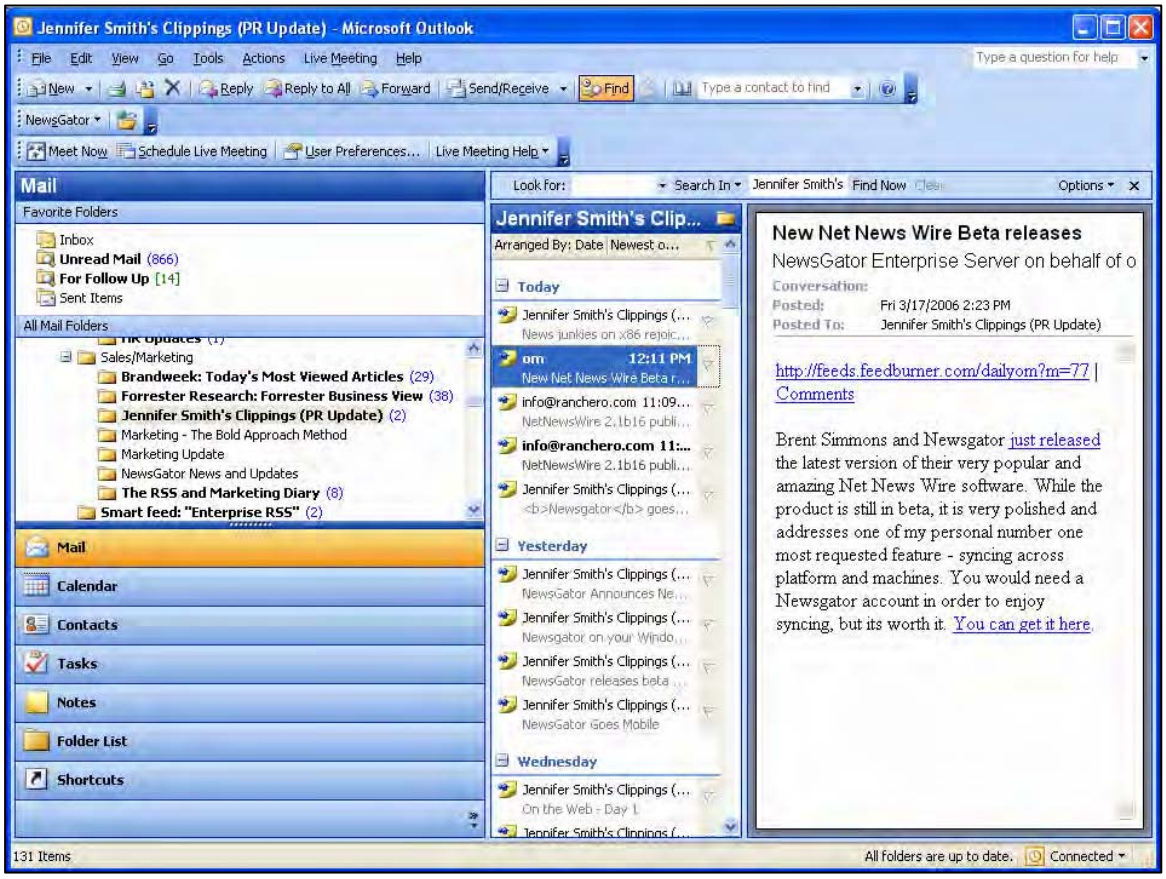

Figure 24. NewsGator's Microsoft Outlook Plug-in for Reading RSS Feeds.[75]

Figure 25. An Example of a Scrolling RSS Feed Reader.[76]

[75] http://www.newsgator.com/img/ss/enterprise-2.jpg (accessed July 21, 2006).

[76] http://www.enewsbar.com/tour.php (accessed July 21, 2006).

Offline aggregators can also be separate program such as the scrolling feed reader showed in Figure 25. Additionally, desktop applications can provide more features and customization. For example, Attensa has developed a program that integrates with the web browsers and Microsoft Outlook, as well as provide it's own interface and tracks the users feed reading activities. The new capability called AttentionStream, monitors the users habits and preferences and re-arranges feeds based on what it deduces the user would be more interested in.[77]

Aggregators are also beginning to work with mobile devices such as portable audio devices, cell phones, text messaging, and chat. Finally, even the need for enterprise level aggregation has become recognized with development of feed search engines and enterprise feed servers.

2. Feed Servers

One recent commercial development in particular has best embodied the potential of web feeds the web feed server. In October 2005, NewsGator released a web feed server called the NewsGator Enterprise Server (NGES).[78] Recently, Attensa and KnowNow entered the market with their own Enterprise Web Feed Servers in July 2006. These web feed servers are an integrated server that provides two key features: (1) it provides users with a customizable, online intranet-based aggregator, and (2) it provides the intranet it is attached to the capability to easily manage, monitor, and generate both internal and external RSS feeds. These two key features could provide a catalyst for an organization to use web feeds to share information.

[77] http://www.attensa.com/products/outlook/reasons/1/ (accessed July 21, 2006).

[78] http://www.newsgator.com/news/archive.aspx?post=97 (accessed July 21, 2006).

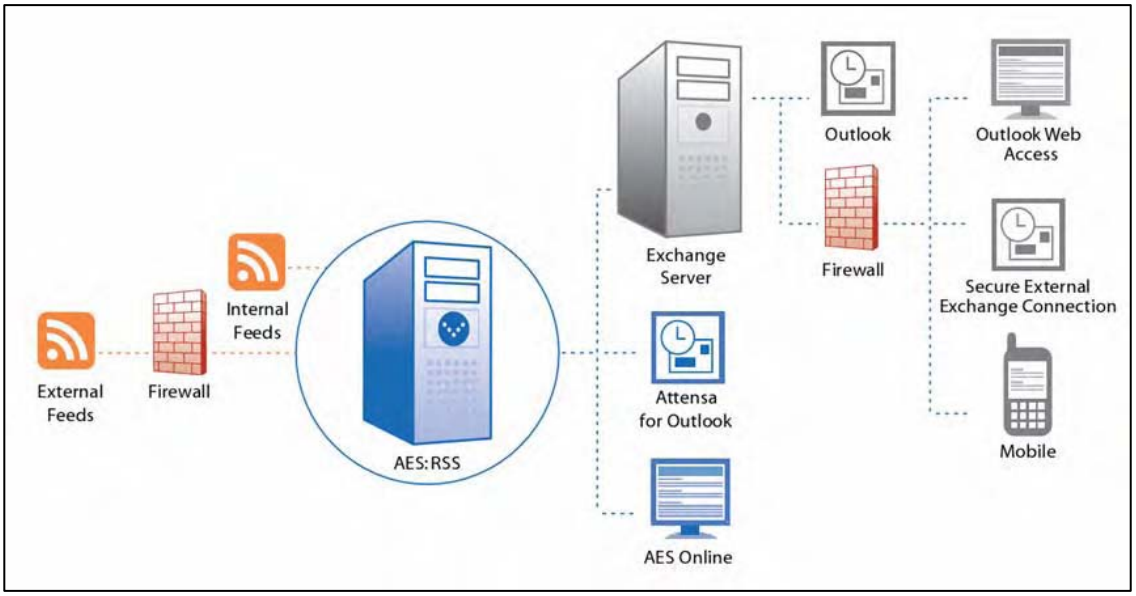

Figure 26. A Diagram of How a Web Feed Server Fits in An Organization.[79]

As can be seen in Figure 26, by providing the capability for an intranet based aggregator, administrators can centrally manage the system, avoid installing software on every computer, but keep sensitive information inside of the organization's firewalls. By providing the robust web feed generator, it provides the capability for an organization's information managers to setup logical information flows to support the organization's people and processes.

3. Visualization

One of the draw backs of web feeds is the capability to visualize the data and information. Two interesting trends in visualization are beginning to reach a tipping point: Geotagging and Tag Clouds.

Geotagging is the embedding of geographical coordinates into the feed. Geotagging is being made popular my geo-blogging, where bloggers create entries with pictures of locations and/or blog their location. With a geotag, information can been tied to a geographic location, it can be used to present a what could be described as a common operating picture in Figure 27, except this type of overlay can provide a better description of ones current information environment.

79 Enterprise RSS: The Center of Attention, an Attensa White Paper. 2006. Portland, OR: Attensa, 060609-v1.1, http://download.attensa.com/resources/Attensa_Enterprise_RSS_WP_060512.pdf (accessed July 21, 2006).

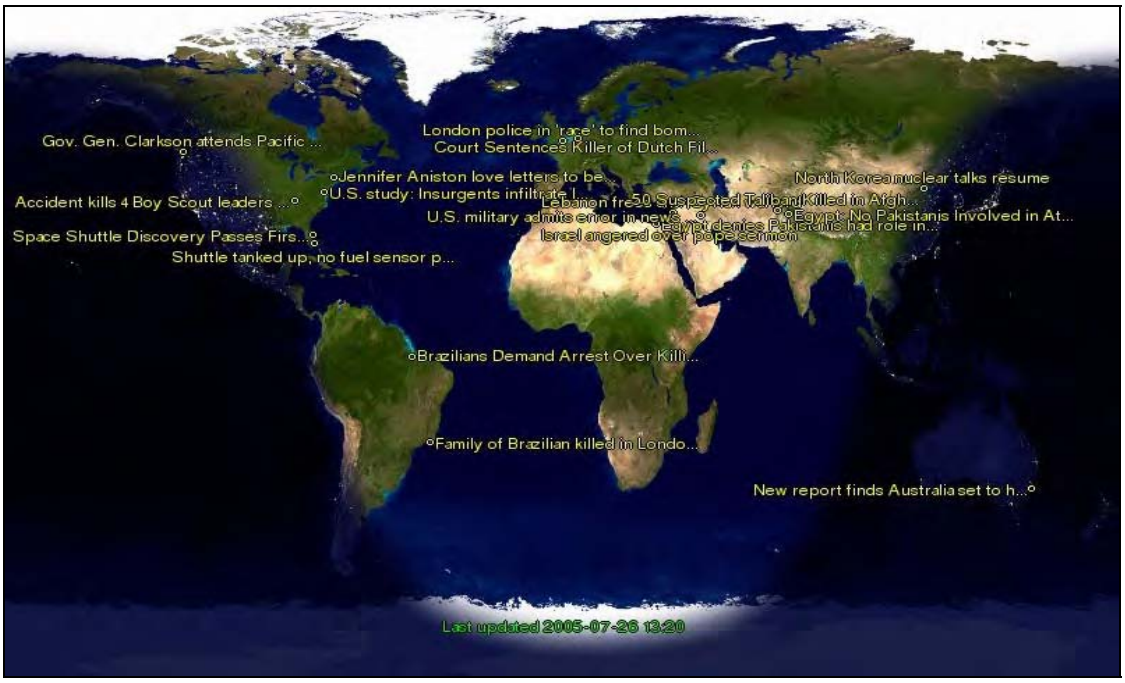

Figure 27. An Example of Geotagged Feeds Graphically Displayed on a Map.[80]

Tag clouds are another "growing" phenomenon with web feeds. Made famous by the photo-sharing website, Flickr, tag clouds are a weighted list of a certain number of the most common keywords. Instead of using a formal taxonomy, where there is a hierarchy of keywords for user to use, Flickr uses a folksonomy, a self-synchronizing group method of users freely choosing their own keywords to label content. In Flickr's case the users are freely labeling what the subject of the pictures they are posting, since pictures cannot be easily indexed by normal search engines. Flickr generates web feeds of the pictures based on the folksonomy.

[80] http://home.arcor.de/mdoege/rss-planet/sample2.jpg (accessed July 20, 2006).

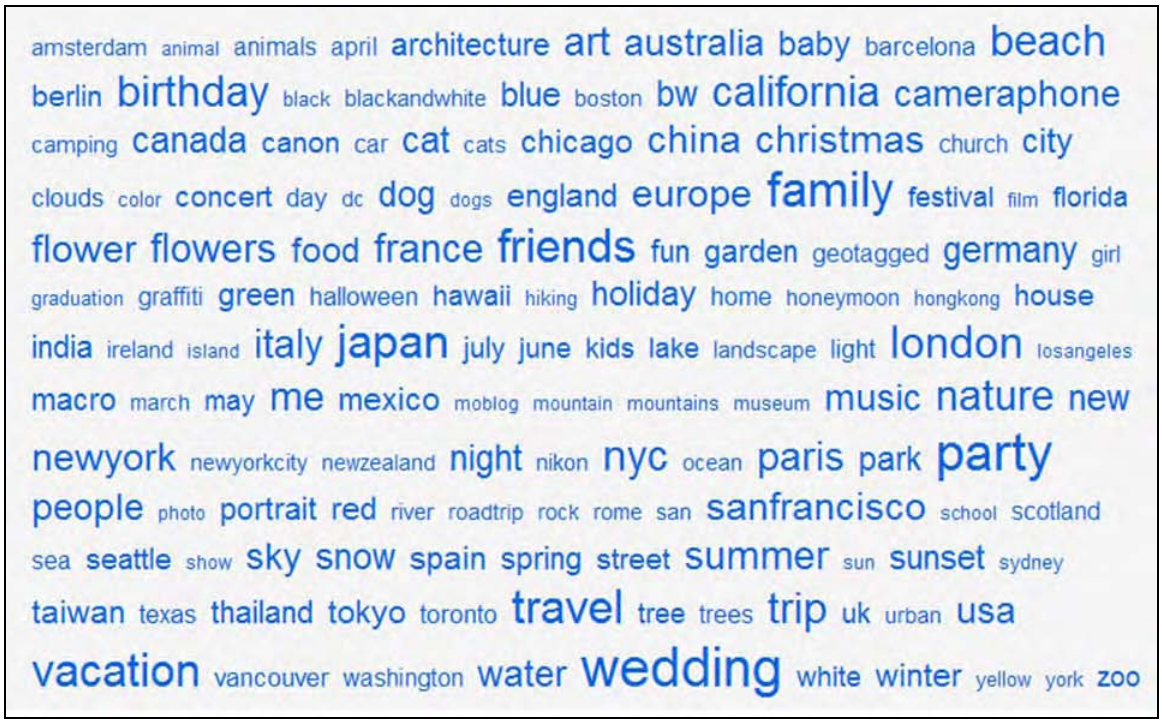

Figure 28. An Example of a Tag Cloud.[81]

As can be seen in Figure 28, the more common a word is used the relatively bigger the word gets in the tag cloud, allowing users to find the most common keywords. This same method could be used for showing the popularity of keywords in a variety of contexts that are fed through web feeds.

F. INFORMATION SECURITY

In accordance with the concepts of Defense in Depth, it would be improper not to discuss Information Assurance and web feeds. Generally speaking web feeds are webpages, so logically web feeds can be as protected as webpages can. There is one exception to this logic, the program reading the feed must have the capability to support the authentication method used by the server hosting the web feed.

The three basic parts of Information Assurance are confidentiality, integrity, and availability. In examining web feeds, confidentiality can be obtained through the standard methods of encryption using either public or private keys. Integrity could be obtained by the author of the contents of a feed element digitally signing the contents, or a system digitally signing the feed. Availability would be hard to protect, however, web feeds are

[81] http://www.flickr.com/photos/tags/ (accessed July 20, 2006).

easy to be monitored and copied and could be afforded some protection with multiple referencing of feeds.

As the popularity of using web feeds for information sharing has grown, there has also been the recognition that there might be a need to protect that data. To that end, the two most common methods have been to: (1) embed a hashed result of the user's username and password into the feed to generate custom requests that can provide some capability to recognize the user, and (2) use the usual webpage protections such as LDAP and SSL, although highly limits the user's choice of aggregators.

G. SUMMARY

There are a number of potential military applications for web feeds. Web feeds allow for the customization of information flows. These customized flows can be dynamically molded around different user, different processes, and different technologies, instead of the other way around. This allows for reduction of friction and a high potential for information to flow through out an organization, facilitating information superiority and providing a foundation for decision superiority.

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V. SYSTEMS FOR THE DIGITIZATION AND MANAGEMENT OF INFORMATION

A. CUSTOMIZABLE PORTALS: USER-DEFINED OPERATING PICTURES

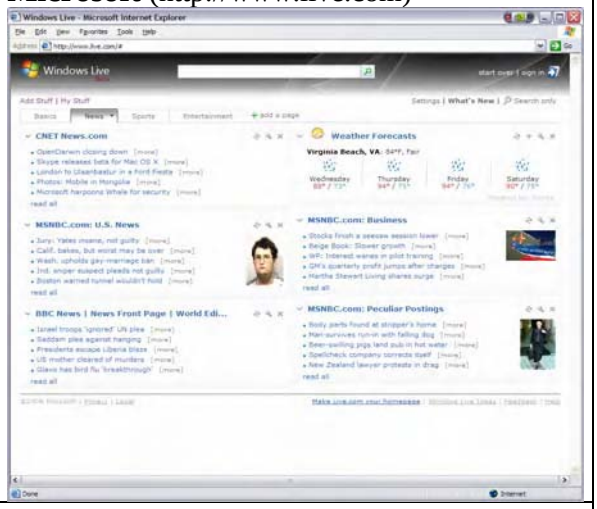
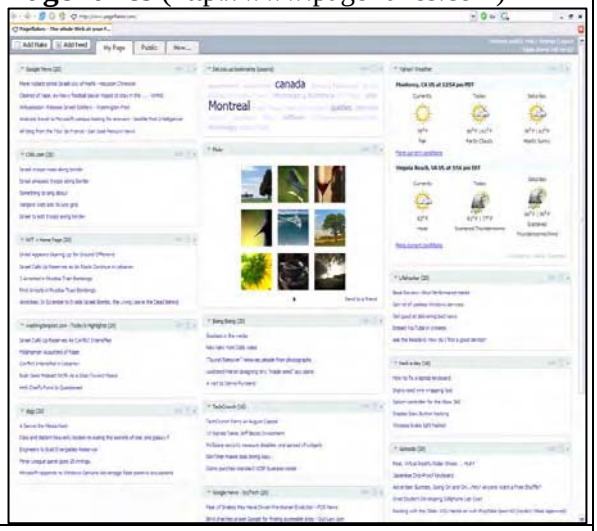
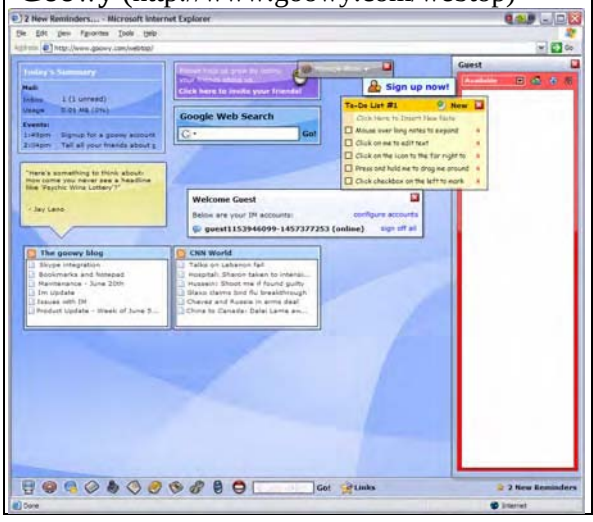
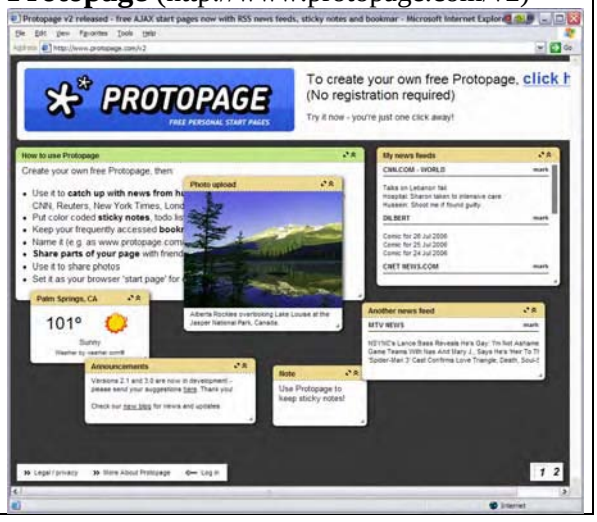
A portal is an entry way for users to enter a system. Although there are a number of different ways of accessing information NCOWFA type systems, portals will be the key method. Historically, web portals were simply websites that users could start at when accessing the Internet. Before the broad usage of search engines, portals were typically directories of links for users to find information. Portals continued to evolve mostly replacing directories for search engines. Portals have also grown to be application hosts for complimentary systems that work inside or alongside portals called portlets, systems such as email managers, calendars, and announcements. With the constitution of Web 2.0, portals have continued to evolve into user customizable interfaces. These user-defined web interfaces mostly taking the form of web-browser based desktops, capable of tailoring the web feeds and portlets in a robust display, several examples of this type of interface can be seen in Table 3. As web feeds are the "bringers" of information, the portals are the gateways to accessing that information.

Although each content systems in NCOWFA may have its own web interface, a portal is still very relevant to the broad need that will be required for a user to manage and stage their information flows. Inversely, portals can have other systems such as web feed servers, wikis, blogs, or file servers incorporated into them through the direct inclusion of those systems or the use of mutually supported portlets. Arguably, a majority of the wiki, blogs, and other systems that are part of NCOWFA originated as additional features or a derivation of a portal. Portals being the model for most other systems have resulted in their supporting software packages being not only the foundation for portals, but all of the other systems as well. Thus all of web browser based systems share the same shades of underlying software packages to build them.

1. Different Shades of Web Portals

There are several different categories that the most recent generation of portals can be described as. There are Internet companies hosting their own custom web portal, whose goal is to operate portals for a general Internet user to use, potentially generating

Table 3. Popular Hosted Personal Internet Web Portals.

Google (http://www.google.com/ig)	**Microsoft** (http://www.live.com)
	
Netvibes (http://www.netvibes.com)	**Pageflakes** (http://www.pageflakes.com)
	
Goowy (http://www.goowy.com/webtop)	**Protopage** (http://www.protopage.com/v2)
	

profits from advertising, co-branding, or hosting fees. They work to attract users to create a personal entry point to the Semantic Web through their portal system. These portals systems can be just portals or an amalgamation of different subsystems. Table 3 is a list of some of the more popular hosted personal portals with examples of their site.

There are also companies and organizations that pre-build web portal systems, intended for use on intranets or community websites. In terms of the dealers of web portals, the foremost difference between these web portals is their philosophy in openness. There are proprietary systems such as Microsoft SharePoint, Oracle Portal and IBM Websphere. There are also completely open-source systems such as Drupal at the other end of the spectrum. Additionally, there a happy medium of the two philosophies, where companies produce open-source systems and then sell consultation services and more advanced systems with additional features. Examples of these happy mediums are systems such as Liferay and eXo Platform.

The interesting trend of popular pre-built systems is that the more open they are, the larger the size of the social community of programmers working to add to it. These communities can act as force multipliers for the system by freely providing the injection of bleeding-edge technologies and additional functionality. The degree of openness is a current trend that has an effect on all the emerging Internet technologies and is covered in greater detail in Chapter II. In summary, however, there are trade-offs between systems that are open and proprietary, but proprietary systems are generally more restrictive in the end and less conducive to interoperability. Of the open pre-built systems, they are typically programmed in one of two web platform application stacks: Java EE or LAMP.

The full open-source web portal systems are most commonly LAMP systems. LAMP is an acronym for the combination of subsystems used: the Linux operating system, the Apache web server, the MySQL database server, and either Perl, PHP, or Python as the programming language. WAMP and WIMP are variation of LAMP, where the system is installed on the Microsoft Windows operating system and in case of WIMP, with Microsoft's Internet Information Server, instead of Apache web servers.

The open-source based, contract supported web portal systems are most commonly Java EE based. Recently renamed to Java EE or Java Platform, Enterprise

Edition, the system was originally referred to as J2EE. J2EE is an acronym for Java 2 Platform, Enterprise Edition. J2EE was originally developed by Sun Microsystems. The "2" was dropped from the name in the most recent specification Java EE 5, under the Java Specification Request 244 (JSR-244) released in May 2006[82]. Java EE is programmed entirely in the Java programming language. Java, however, is capable of operating on multiple platforms, so there is no need to differentiate between the different operating systems as LAMP related systems do. Typically one of two open source application servers are used for a Java EE system, either JBoss, recently purchased by Red Hat, or Geronimo, managed by Apache. LAMP type systems do not typically use application servers as they are usually more directly part of its subsystems as compared to the Java EE systems which rely heavily on portlets.

LAMP systems are the more common full open-source systems because of the relative ease of web server hosting companies to host such systems, a Java EE system by comparison, typically requires its own server with user root access for installation. LAMP systems have a reputation of being collaboration systems for dynamic social networks, because of how quick a system could be deployed on the Internet through a hosting company. Alternatively, Java EE systems have a reputation of being oriented towards business based collaboration systems. Both groups have excellent offerings and reputable systems, but have these generally different reputations due to the inherent characteristics of their server requirements and supporting business models.

Figures 26 and 27 are examples of some of these different types of systems. Figure 26 is the portal that US Joint Forces Command (JFCOM) deployed in support of Multi-National Force Iraq (MNF-I) in early 2005. The MNF-I Portal is an example of the eXo Platform system. Additionally, the advanced file server Xythos, was installed, as its portlet can be seen under the Hot Documents area. Figure 27 is the Naval Postgraduate School (NPS) Detachment Katrina Portal, which was used as a both the detachment's Command and Control system, as well as, a collaboration system with its many partners. Called the IPWiki, due to domain name, it is an example of a Drupal system configured to function as both a portal and a wiki.

[82] http://jcp.org/en/jsr/detail?id=244 (accessed July 23, 2006).

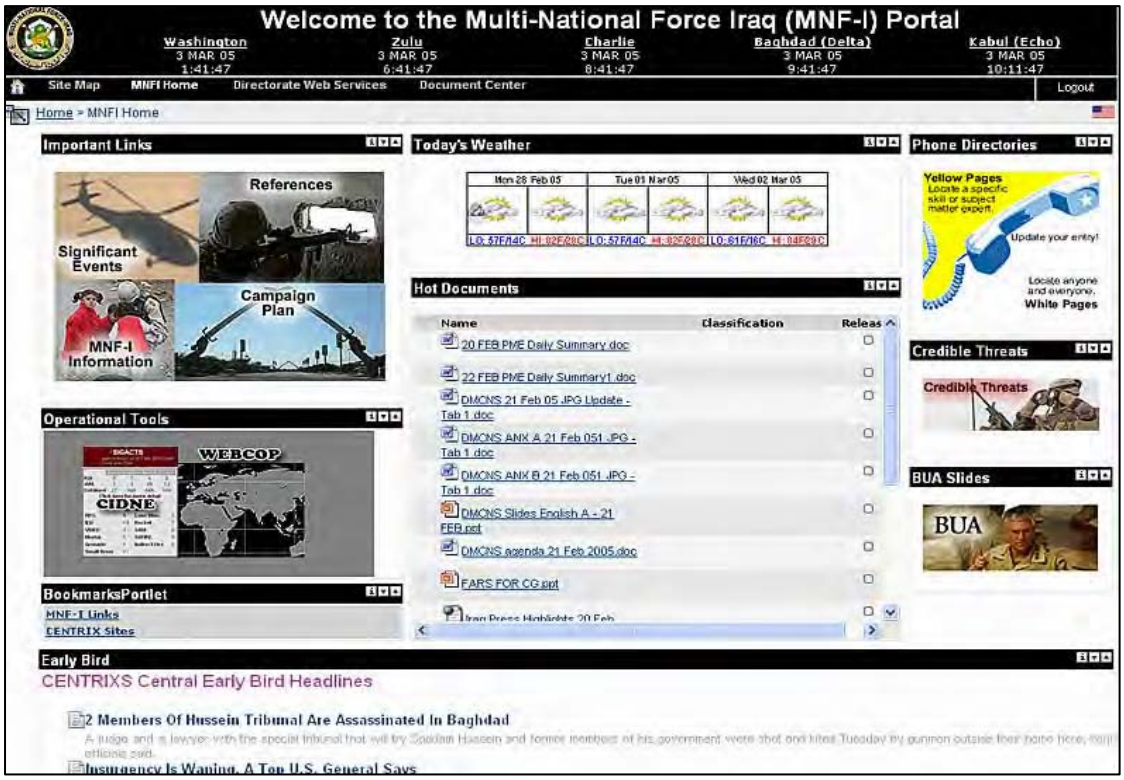


Figure 29. USJFCOM J9 Deployed MNF-I Portal.[83]

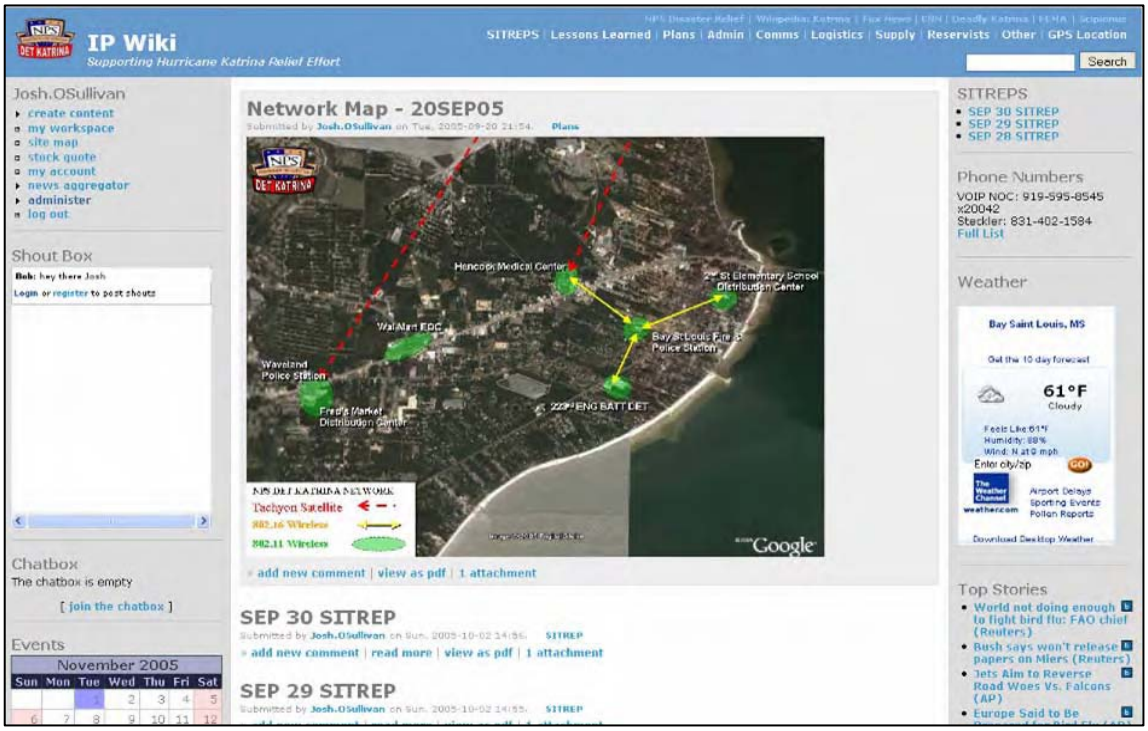


Figure 30. NPS Det Katrina Portal/Wiki.[84]

83 http://i.cmpnet.com/infoweek/1032/iraq.jpg (accessed July 23, 2006).

84 http://www.ipwiki.com/portal (accessed September 30, 2005).

Lastly, there is the choice to custom build a system. By custom building a system, the benefits are fairly obvious, but there is a large amount of basic work that a programmer would need to do, the whole notion of re-creating the wheel. System requirements and specifications would need to be decided upon, underlining databases would need to be designed, web interfaces would need to be drawn and tested with different browsers. Additionally, the system might well be an island of isolation in a sea of interoperability, if the "right" standards are not implemented. To help add the capability for user extension, many custom portal operators will provide an Application Programming Interface (API) for users to build add-ons or merge the system with another system to create what is called a mashup. To help reduce the redundancy of custom building a web portal, a number of programming systems can be used to build the system. The three most common portal programming systems are Java EE, Microsoft's ".Net," and Ruby-on-Rails. All three systems have many advantages and are able to have a portal operational quickly and easy, through the work of a knowledgeable programmer. The main divisions between the three are that Java EE can work on multiple host operating systems, but uses only Java as a programming language. .Net, is the inverse of Java EE, it can only work on Microsoft Windows host operating systems, but supports multiple programming languages. Ruby-on-Rails is an advent of the Web 2.0 phenomenon that uses the Ruby programming language, which is fairly similar to Java, to quickly build web applications with minimal lines of code and provides advance user interface features. Ruby-on-Rails has similar qualities as LAMP pre-built system do and can be installed on multiple operating systems as well.

Pictured in Figure 28, Navy Knowledge Online (NKO) is an example of a custom built Java portal. From personal experience, there have been a number of integration issues, in terms of developing supportable portlets for the system, as well as, general user interface issues. NKO is currently in its second iteration and will be replaced, along with the other service's portals with a DoD wide Knowledge Online (DKO) portal.[85] Most of the issues brought up by users have focused on user interface issues, as well as, inability to access it from ships or other low-bandwidth locations. NKO is a good example of

[85] http://www.gcn.com/online/vol1_no1/40968-1.html (accessed August 12, 2006).

some of the other problems that can occur when custom building a portal system and not building for interoperability.

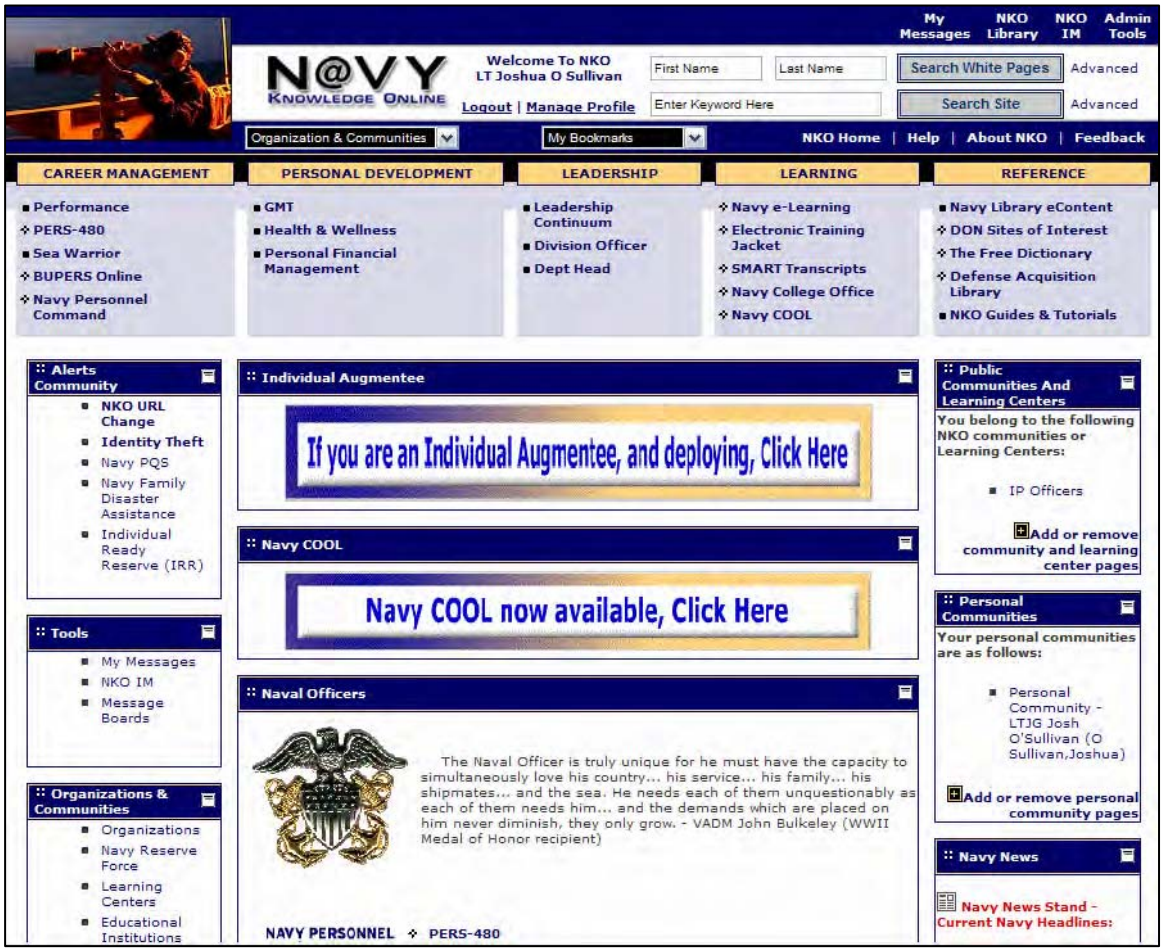


Figure 31. Navy Knowledge Online.

Regardless of which way a web portal is implemented, if attention is paid to following certain concepts, then the system can still attain a high level of interoperability. Most importantly, for a portal to work in NCOWFA, it is imperative that it is a robust web feed aggregator and capable of easily and efficiently handling web feeds. Additionally, if the web portal supports the emerging portlet standards, it would have the additional benefit of being able to re-use portlets and better integrate with the other systems that support those standards.

2. Portlets

With the most recent metamorphosis of web portals to the embodiment or user-customizable access, portlets have shifted from insignificant to critical. Web feeds are fairly easily and universal in its capability to share content between websites, however,

for closer integration of systems, an actual interface for the complimentary system may be desired over the straightforward listing of information. Portlets could be viewed as a richer, more customized version of web feeds.

For example, a portal that supports the same portlet standards as a wiki and file server could then directly integrate the wiki and file server interfaces into the web page. The inverse can also be true, where wikis and file servers have portals packaged with them to provide the user interface. Unfortunately, portlets have historically been portal to content provider specific and devoid of reusability, let alone interoperability. Portlets have usually been customized extensions of a particular portal or a specialized hack for two disparate systems to be bridged together. Recently, there has been work to add interoperability to portlets, so that designers of systems can provide a reusable portlet for portals to be used for a richer integration. This would be the equivalent of each automobile model requiring its own custom type of headlights, wheels, and seats, now shifting to the capability of being able to share parts with other vehicles and the automobile is only a chassis for these parts. Two specifications have emerged to help add interoperability: Web Services for Remote Portals (WSRP) and the Java Portlet Specification, Java Specification Request 168 (JSR-168).

WSRP is an approved standard protocol by the Organization for the Advancement of Structured Information Standards (OASIS) for sharing content and interactive web applications between web services and portals. [86] WSRP is technologically neutral and able to be used with multiple types of systems particularly Java EE and .Net implementations.

The Java Portlet Specification (JSR-168) is an approved standard by the Java Community Process for using interchangeable portlets in Java based systems. JSR-168 compliments WSRP, by covering the Java specific usages and interactions with portlets and the underlying function calls for different systems to call.

3. Information Security

If web portals are the interface for users to regularly access content, how can the users be authenticated for access to that content? It would be extremely inefficient to

[86] http://www.oasis-open.org/committees/download.php/3343/oasis-200304-wsrp-specification-1.0.pdf (accessed July 24, 2006).

authenticate with each system and users do not like logging into multiple systems repeatedly. It would also be impracticable to allow access without user authentication. To solve this problem, a central authentication server could be used.

For example, the JA-SIG Central Authentication Server is an open-source system that is compatible with every web portal implementation discussed in this section. As seen diagramed in Figure 29, it functions acting a middle-man in between the user and the different servers. Typically, a user will try to access information from a system, and be redirected to the authentication server, with the initial server's identification code. The authentication server will then authenticate the user, and is the user some kind of token, such as a service ticket. The user's web browser then re-connects to the initial server and sends the ticket, which the server then validates with the authentication server. This type of authentication could complement current DoD initiatives with Public Key Infrastructure (PKI).

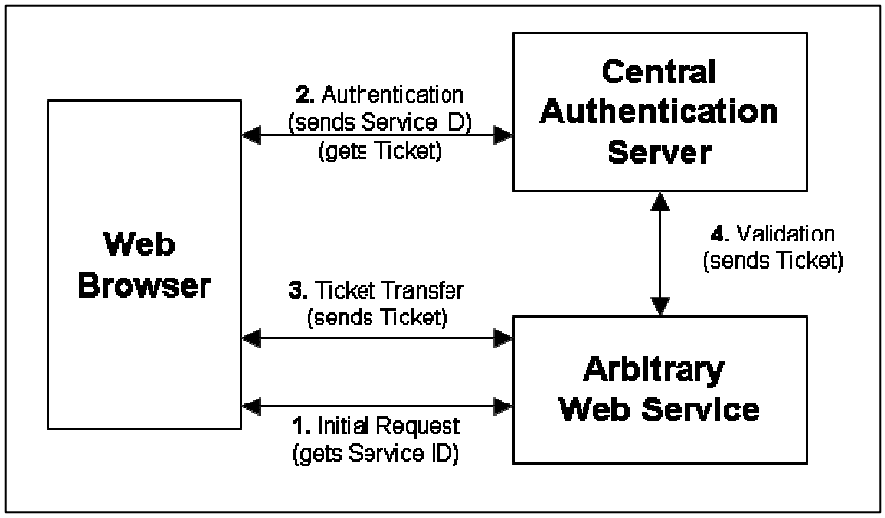


Figure 32. The Authentication Scheme of a Central Authentication Server.[87]

4. Summary

Portals are the foundation of an NCOWFA-based system. While users do not need to use a portal to monitor their web feeds or work in the system, for the majority of implementations a portal will be the average user's homepage. Portals provide the basic building blocks for constructing other systems. This includes future NCOWFA

[87] After: http://www.ja-sig.org/products/cas/overview/cas1_architecture/index.html (accessed July 26, 2006).

compatible systems, as long as they support syndicating and aggregating web feeds and (preferably) an open-standard portlet system. Unfortunately, while usually misunderstood as an entire system, portals are only a part of an NCOWFA-based system of systems.

B. BLOGS: WEB-ENABLED LOGS

Blogs are a space for posting information. Usually a blog is operated by one poster, but there are also group blogs with multiple posters. Although initially blogs were simply web based logs or online journals, they have expanded in capabilities to the point where it is the easiest way to publish any content on the Internet. Traditionally, blogs have a capability to interact with readers, such as a place for users to post and read comments. Blogs can be used internally in organizations to post questions, pass information, or voice general opinions. Blogs can be used externally by organizations for public affairs, providing individual views and support, as well as focusing on a particular topic.

Blogs have become a direct competition to the worlds media and is driving the train, so to speak, through the information network. It was a blog that broke the Monica Lewinsky scandal, and blogs exposed Dan Rather's use of fraudulent documents during the 2004 US Presidential elections.[88] Why are blogs becoming so prevalent? Because they are the easiest way for average people to publish in the world and blogs give a voice to every user. Typically, adding content is similar to using a word processor, with a What-You-See-Is-What-You-Get (WYSIWYG) environment, users do not need to know how to make webpages, they just simply type. As seen in Figure 33, blogs can be rather basic, but very effective in publishing information.

[88]http://www.drudgereport.com/ml.htm (accessed July 21, 2006).

James Kinniburgh and Dorothy Denning. 2006. Blogs and military information strategy. Hurlburt Field, FL: Joint Special Operations University, 06-5: 1-2.

DRUDGE REPORT

Web Posted: 01/17/98 21:32:02 PST -- NEWSWEEK KILLS STORY ON WHITE HOUSE INTERN X X X X X BLOCKBUSTER REPORT: 23-YEAR OLD, FORMER WHITE HOUSE INTERN, SEX RELATIONSHIP WITH PRESIDENT

Web Posted: 01/17/98 23:32:47 PST -- NEWSWEEK KILLS STORY ON WHITE HOUSE INTERN

BLOCKBUSTER REPORT: 23-YEAR OLD, FORMER WHITE HOUSE INTERN, SEX RELATIONSHIP WITH PRESIDENT

World Exclusive
Must Credit the DRUDGE REPORT

At the last minute, at 6 p.m. on Saturday evening, NEWSWEEK magazine killed a story that was destined to shake official Washington to its foundation: A White House intern carried on a sexual affair with the President of the United States!

The DRUDGE REPORT has learned that reporter Michael Isikoff developed the story of his career, only to have it spiked by top NEWSWEEK suits hours before publication. A young woman, 23, sexually involved with the love of her life, the President of the United States, since she was a 21-year-old intern at the White House. She was a frequent visitor to a small study just off the Oval Office where she claims to have indulged the president's sexual preference. Reports of the relationship spread in White House quarters and she was moved to a job at the Pentagon, where she worked until last month.

The young intern wrote long love letters to President Clinton, which she delivered through a delivery service. She was a frequent visitor at the White House after midnight, where she checked in the WAVE logs as visiting a secretary named Betty Curry, 57.

The DRUDGE REPORT has learned that tapes of intimate phone conversations exist.

Figure 33. Drudge Report Initial Posting of the Monica Lewinsky Scandal.

1. Ways to Blog

As the popularity of blogs has grown, so have the ways to post to them. The content posted to blogs can usually range from text, to pictures, to videos, or other files. The potential organizational application of using different posting techniques should be taken into account for all forms of portal systems, as they ease the initial learning curve for first time users, as well as provide flexibility to users in how they post and use a system. This flexibility translates well into capabilities for supporting legacy systems. For instance, there are some systems that will generate and send emails based on particular rule sets, some blogs have the capability of receiving posts via emails, so a legacy system could be integrated into a NCOWFA-based system, by sending its outputs to a blog that is linked to the information network by web feeds.

Besides posting received emails, blogs have a number of other integrating capabilities. Some blogs have taken the step of incorporating cell phone access to blogs, where users can simply call in and record messages, use the cell phone's mobile web browser to post to and read blogs, send text messages of text, pictures, or videos to be posted to the blog, Users can even use a program to post their geo-location information and post it to a blog as shown in Figure 34.

Figure 34. Popular Science Magazine's Example of Cell Phone GPS Tracking.[89]

Finally, there is the use of automated agents, such as chatbots to acts as a relay between chatrooms and blogs or other systems. In particular, chatbots could be used to monitor chatrooms for keywords, respond to queries for other systems, and post content as is demonstrated in Figure 35.

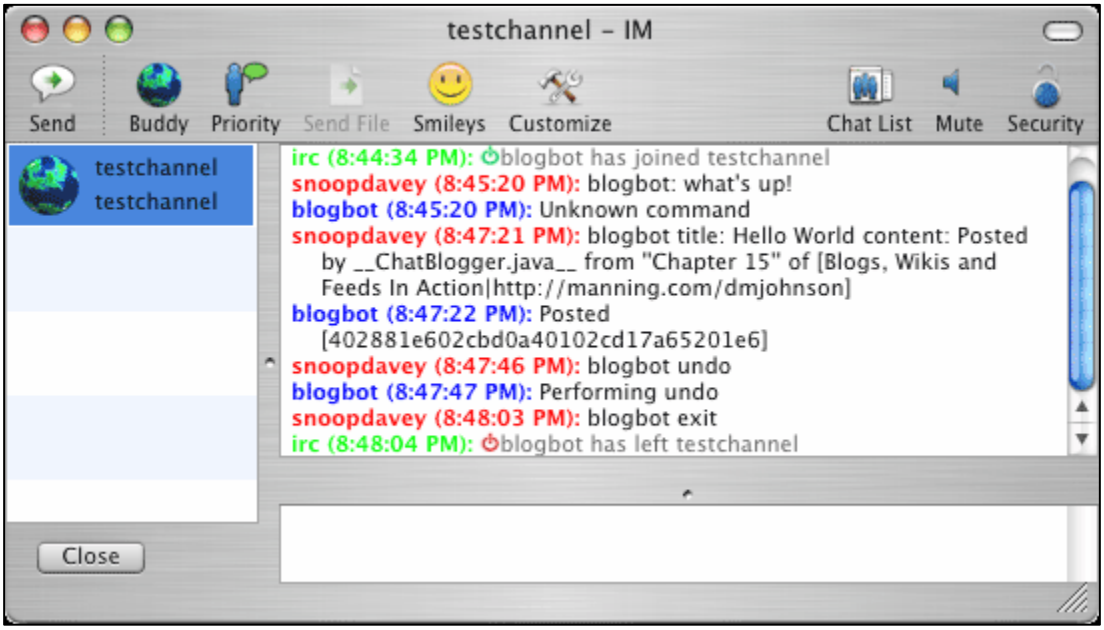


Figure 35. Example of a Chatbot Creating a Blog Entry.[90]

[89] Ethan Todras-Whitehill. 2006. Track anyone with A cell. Popular Science 268, (5) (May): 86.

[90] http://rollerweblogger.org/page/roller?entry=wiki_bloggin_chatbot_in_action (accessed August 15, 2006).

2. Information Security

A typical practice for watch teams is to use generic group user accounts. The reason a generic account is typically used is because it removes the need for users to log into a system and logout, as well as provide a general watch email address. Logically, this is a bad practice in terms of Information Assurance, as it provides an account that is not tied to anyone person, so it's password is usually easier and more available, as well as no accountability for user actions or of a user noticing someone using their account.

Shifting from a computer based system to a web browser/network based system, allows for the elimination of this practice. A portal system can be used to monitor chat rooms and group email address. Additionally using a group blog, where multiple users make their own entries on one blog, provides accountability in who makes what report, as well as the capability to turn over a watch, while maintaining the ability to log the user off of a computer. A watch could also sign their log, post on the blog with a digital signature, providing both digitalization of their information and non-repudiation of the watch officer's actions. This watch portal and blog would also add the ability for the watch officer to customize their information formats and sources, as they are typically changed or kept generic with the generic user account method.

3. Summary

Blogs are the way to quickly and efficiently digitize information for use in NCOWFA-based systems. They are the fundamental system for generating content that is entered by a single user and provide multiple avenues for users to enter content. Blog is a concept in it infancy in the US Military, as well as the DoD, however, will continue to grow in its integration and application in a wide range of environments.

C. WIKIS: WEBSITES THAT ANY USER CAN EDIT

Wikis are a type of website that any authorized user can edit. In many cases, a wiki is setup to allow for any user, including the general public, to edit the contents of the pages. To edit a page, a user will usually only need to click the edit button and start typing. Most wiki systems handle formatting pages with specialized markup languages for formatting content, creating new pages or sections on a page, as well as other system operations. Ideally, content entry should be more like blogs, adding content as one would

in using a word processor. There is a growing trend to make wikis more user-friendly as they enter mainstream and move from away their more eclectic use by advanced users. Most wikis do have a robust "history" function, allowing for any change to be undone, including a rollback. The history function eliminates the threat of loss work in a community driven environment, as well as mitigate vandalism in public available systems. Someone defacing a wiki can be a concern, but such vandalism is usually fixed in a matter of minutes compared to the days of a normal webpage.[91]

The first wiki, WikiWikiWeb, was released in 1995 by Ward Cunnigham for the Portland Pattern Repository and is still available for edits and additions.[92] WikiWikiWeb was named after the Honolulu International Aiport's shuttle bus, the Wiki Wiki, which comes from the Hawaiian word "wiki," which means fast. The reason why Mr. Cunningham named his creation after the shuttle bus was because his creation was intended to be able to be edited quickly.[93] With the popularity of Wikipedia, a wiki-based encyclopedia, wikis have emerged as useful tool for networked collaboration. Ideally, wikis can function as a body of knowledge, allowing a community of users to share their explicit knowledge.

[91] Fernanda Viegas, Martin Wattenberg, and Kushal Dave. 2004. Studying cooperation and conflict between authors with history flow visualizations. Paper presented at CHI 2004, Vienna, Austria, http://alumni.media.mit.edu/~fviegas/papers/history_flow.pdf (accessed July 26, 2006).

[92] http://c2.com/cgi/wiki?WelcomeVisitors (accessed July 25, 2006).

[93] http://en.wikipedia.org/wiki/WikiWikiWeb (accessed July 25, 2006).

1. Wikipedia

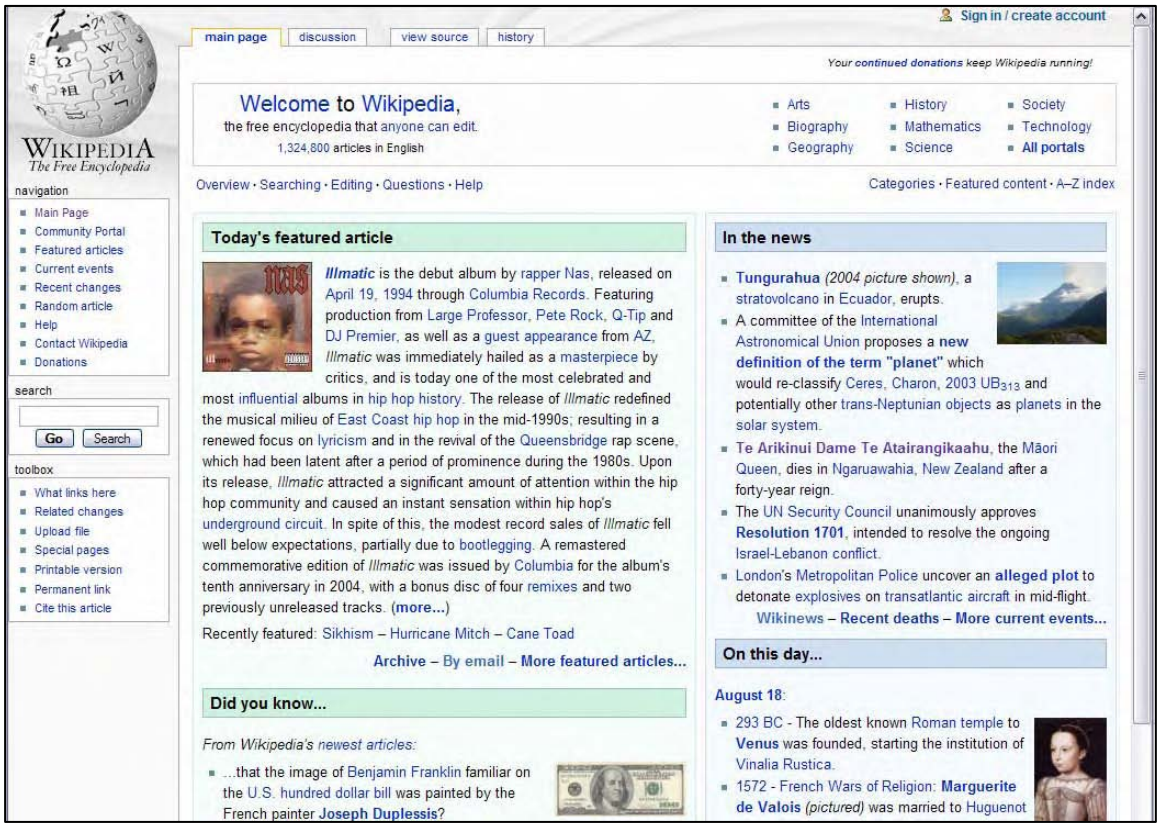


Figure 36. The Wikipedia English Version Main Page.[94]

Wikipedia is the quintessential wiki and it has led the way for wikis into the Internet mainstream. Wikipedia originated in 2001 as a side project for the development of articles before entering a peer review process for the Internet encyclopedia Nupedia, as Wikipedia grew in popularity Nupedia declined, until it was ultimately incorporated into Wikipedia. The goal of Wikipedia became to "create and distribute a free encyclopedia of the highest possible quality to every single person on the planet in their own language."[95] Although, its reliability and accuracy has been questioned, it has become a starting place for Internet users to gain knowledge and find related information. An infamous peer review by the journal Nature, compared articles from Wikipedia and Britannica, the oldest reference work in the English language, and reported an average of four Wikipedia article inaccuracies to three Britannica article inaccuracies.[96] The results were disputed in

[94] http://en.wikipedia.org/wiki/Main_Page (accessed August 18, 2006).

[95] http://mail.wikipedia.org/pipermail/wikipedia-l/2005-March/038102.html (accessed July 27, 2006).

[96] Jim Giles. 2005. Internet encyclopaedias go head to head. Nature 438, (7070) (Dec 15): 900.

a lengthy open letter by Britannica, which was rebutted by a Nature editorial. [97]Comparatively, it is not argued that Britannica is more accurate and more reliable than Wikipedia, however, Wikipedia would appear to cover far more subject matter and contain articles on current events and contested subjects. Wikipedia is an excellent starting point and serves to be a major information hub in the scale-free network of the Internet, as consistently one of the top 20 Internet sites as per Alexa, a recognized Internet traffic ranker.[98] Wikipedia is an excellent example of the unique method for a user to become roughly informed of a subject within a common body of knowledge quickly and efficiently by using a wiki.

The wiki software that Wikipedia uses is called MediaWiki. It is an open-source LAMP based system, however, will also operate in a WAMP environment. Some of the key capabilities MediaWiki has is a discussion and history page bound with each wiki page and several organic web feeds. Each wiki page supports a web feed of its changes, as well as a recent changes and new pages feed for the site. It would be useful, if MediaWiki better supported feed to more efficiently integrate it into a NCOWFA-based system, such as recent changes and new pages with particular keywords or in a certain category. Potentially, a web feed server could be setup to monitor the two site feeds and create keyword or category feeds from those feeds, however, it is more efficient for a system do it internally.

With the growth of the popularity of Wikipedia, MediaWiki has become more popular for use as organizational wikis. Figure 37 is an example of the PIMSWiki, managed by SPAWAR Europe, it is used as a focal point for collaboration and information exchange between NATO countries and former Soviet Bloc countries.

[97] Britannica attacks. 2006. Nature 440, (7084) (Mar 30): 582.

[98] http://www.alexa.com/site/ds/top_sites?ts_mode=global&lang=none (accessed: July 27, 2006).

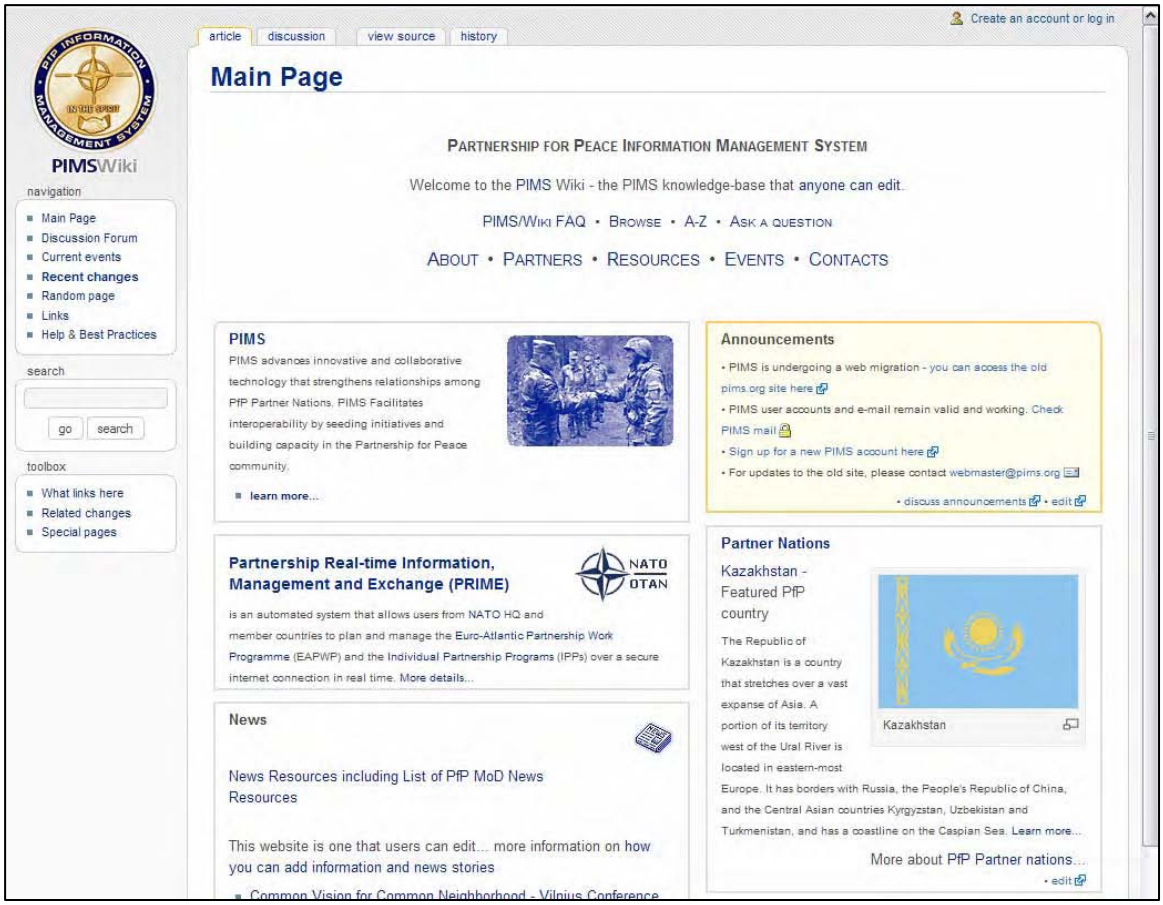


Figure 37. The PIMS Wiki Main Page.

Although MediaWiki comes close, there is no one wiki system, currently available, that is a perfect example of a wiki to be used in a NCOWFA-based system. Fortunately, it is possible to setup portals or content management systems to function as wikis while using the added functionality of the system. For MediaWiki to be the system of choice it will need to develop better web feed syndication and aggregation, as well as add capabilities to manage content. Additionally, there are two capabilities that no wiki system seems to currently support: video integration and PKI. It would be expected that at some point these two capabilities will be integrated, this of course, could be encouraged and funded by a government organization to quickly develop these capabilities.

2. Managing Content

In researching wiki and other similar systems there have been a number of capabilities that are becoming available for managing content that should be considered when choosing or building a system. For ease of reference they are presented in Table 4.

Table 4. List of Notable Capabilities in Wikis.

Capability	Discussion
Web Feeds	Obviously, in terms of syndicating and aggregating web feeds, the better use of web feeds, the better the system can interconnect in a NCOWFA-based system.
Export	There is sometime a requirement to freeze and capture what has been generated on a wiki page. Ideally, to export the page to a PDF file or another type of recognizable file such as a Word file can make things easy. Another option is to be able to lock the page from editing or to convert it to a static webpage.
Display as Presentation	The capability to dynamically display a page as a webpage or a presentation slide. There has been the growth of S5 plug-in to add this feature to wikis.[99]
Language Translation	Typically referred to as Babel Fish translation, it provides the capability to translate between different pairs of languages.
Two-way Email	The capability that allows users to not only post content by email, but have recent change or new pages matching particular rulesets to be sent to a subscribing user. Arguably, as user would not need to directly access the wiki to interact with content, which may be desirable with low-bandwidth connections and legacy systems.
Chatbot Integration	The use of connected autonomous agents that monitor chatrooms to allow users access to a wiki through a chatroom. Chatbots can watch for keywords and record conversations and post them to a wiki, create wiki pages and add content from messages, or run searches against wikis.

[99] S5 stands for Simple Standards-based Slide Show System. It is a web page format specification, developed by Eric Meyers, that allows a web browser to display properly tagged web pages as a slide presentation. For more information reference the standard's homepage at http://meyerweb.com/eric/tools/s5/ (accessed August 13, 2006).

3. Information Security

One of the biggest common concerns of the use of wikis is the integrity of the information, in particular, the reliability and accuracy of information based on an unknown contributor. First, the question of reliability and accuracy has been fairly neutralized by Nature's study comparing Wikipedia to Britannica.[100] Second, there is a need to address who is making changes to a wiki. One of the ways of providing legitimacy, as well as responsibility, is to implement digital signatures with wikis. A digital-signature would provide non-repudiation in terms of a user making a change to a wiki entry. Additionally, the digital signature combined with other user data could provide an analyst or a decision maker, the basis to judge the factuality of certain information. Digital signatures would also presumably neutralize most acts of vandalism, as the user would be signing for their misdeeds and provide a level of responsibility to each user versus an anonymous post.

4. Summary

Wikis are the quintessential workgroup tool. They allow for geographically dispersed teams to work together to develop content. Wikis can function well as a container for a group's body of knowledge, allowing for new members of a group to quickly learn that body of knowledge. Additionally, wikis can provide the whiteboard for a team to dynamically share current information electronically.

D. ADVANCED FILE SERVERS: WEB-ENABLED SHARED DRIVES

With an explosion of affordable large storage capacity there has been a growth in the use of command or group network shared drives. Typically, there has been limited management of these drives, where most users have permission to make new folders and add new files, without any logical naming scheme. These drives become critical for daily functions, however, quickly expand to their limit, as they are also the organization's dumping ground. Additionally, there have only been a few ways to find a file in these drives, in particular installing an indexing system to provide a Google-like search for users. Advanced file servers take shared drives to the next level providing: workflow process, automatic conversion and indexing, and web feeds.

[100] Giles: 900.

1. Java Content Repository (JCR)

In the realm of J2EE, a standard API has emerged for content repository, under Java specification JSR-170. In particular, the API provides a standard API for accessing content repositories, such as a document management system or other advanced file server, regardless of implementation. So if someone develops a system that uses the JCR standard, then any content repository that supports that standard will be accessible. This facilitates the capability of swapping out our upgrading a repository without, the need to change out the system as a whole. Understandable a JCR/JSR-170 compliant system would be a good system to uses in a NCOWFA environment.

JCR works by supplying a theoretical repository model, for systems interfacing with a JCR compliant repository follows. Although the repository would act the same as the theoretical model would act, there are different underlying mechanisms that will be triggered to take the proper actions employed in that particular implementation. There are two levels to JCR functionality. JCR Level 1 is the simpler of the two levels providing only read-only access to the supporting repository. JCR Level 2 provides the additionally functionality of writing content, importing, and managing system structures. An excellent example of a JCR Level 2 compliant repository is the Alfresco Enterprise Content Management system (Alfresco). Alfresco is also a good example of a useful advanced file server in a NCOWFA-based system.

2. Alfresco Enterprise Content Management System

Alfresco is not only the namesake of the sole company product, but also the company itself. Alfresco started in January 2005 by a team of experienced document management software developers and quickly released a highly acclaimed Release Candidate in June, followed by Alfresco 1.0 in October 2005.[101] Alfresco has taken a middle of the road approach to its degree of openness. They have released a full open source implementation called the Alfresco Community Network, with general Linux and Microsoft Windows installations available, as well as including JBoss, Liferay, and Tomcat application server installations. The community version offers no system certifications, warranties, or support other than access to their wiki and forums. A slight variation to typical open source systems, Alfresco employees are the only ones who

[101] http://www.alfresco.com/about/ (accessed August 20, 2006).

update the source code. The source code can be accessed and downloaded, however, with any contributions submitted to Alfresco for consideration in adding to the system and are subject to the company's Standard Contribution Agreement.[102]

Alfresco generates their profits from offering different services in relation to their system. In particular, Alfresco offers a variety of consultation, support, training, and tuning services under the umbrella of two service networks: the Enterprise Network and the Small Business Network. The difference between the two is that the support under the Enterprise Network is for clustering systems, with systems that are tuned to that goal. Service under the Small Business Network is at a per user charge, where under the Enterprise Network it is a per CPU charge.[103]

One of its features that set it apart from a number of other systems is that Alfresco implements the Common Internet File System (CIFS), which provides accessible shared network drives to Microsoft Windows users. This helps ease the transition for a shared drive to an advanced file server. The difference with these shared drives is that they are workspaces on Alfresco, allowing for web access to the files, as well as Alfresco's processes to operate on the file. It is easy for any user to post a file to an organization's information network with this kind of integration. This capability also allows for an easy transition from one to the other. Since Alfresco is a JCR Level 2 compliant repository it could also be used as medium for transitioning from a shared drive to another JCR Level 2 compliant repository that does not offer CIFS.

Aside from the benefits of CIFS Alfresco supports a laundry list of other open standards to allow for easy integration with other systems. Alfresco supports Active Directory and LDAP for single sign-on. Alfresco supports installation on multiple operating systems (Linux, Mac, Windows), multiple databases (Oracle, MS SQL Server, MySQL), multiple application servers (Tomcat, JBoss, JRE 5.0), multiple browsers (MS Internet Explorer, Mozilla Firefox), JSR-168 compliant portals (JBoss, Liferay, eXo Platform), and can use multiple languages (English, Spanish, Chinese, …). Alfresco even offers several APIs for Java, PHP, Ruby and .NET. Unfortunately, with all of its support

[102] http://wiki.alfresco.com/wiki/Source_Code (accessed August 20, 2006, history entry: 18:21, 13 June 2006).

[103] http://www.alfresco.com/products/ecm/comparison/ (accessed August 20, 2006).

for open-standards, Alfresco does not support web feeds out of the box. An installation can be configured to generate feeds, however, and will be robustly supported with the release of version 1.4[104]

3. Summary

Although an advanced file server can also provide confidentiality, the key element of protection provided by these types of system is availability. Without a central storage space for an organization's file, they are spread throughout the organization, in emails, on laptops, thumb drives, and disks. With a share drive, files are at least networked and presumably backed up, providing some level of availability. There is a lack of structure to a general network share drive, making it hard to find files or the information in them. Additionally, a share drive is a simple container, there is no integrated systematic capability for processing, workflows, or information flows, most of the work is left to the users. Advanced file servers provide a high level of availability be providing structure to an organization's files, as well as providing the capability for automated management, workflows, and the capabilities to put files into web feeds. An advanced file server provides the capability to efficiently share the information in files with users both internally and externally of an organization.

[104] kevinr. 2006. *Rss*. Alfresco support forum: Configuration. http://forums.alfresco.com/viewtopic.php?t=1240 (accessed August 22, 2006).

VI. CONCLUSION

A. SUMMARY

The Information Age has brought fundamental change to not only the technology of the world, but to the people, their processes, and their organizations. Although technology acts as a catalyst for the realization of network-centric organizations, technology is not the key, the people are. Any NCOWFA-based system will fail without the proper integration of the people into the system. It is a matter of content, without people understanding and being skilled their role as not only a consumer of information, but also a producer, there will be no content for others to consume. Without content, without digitized information, there will be no information to fill the web feeds, and thus no web feeds for consumers to consume. Fortunately, in the US Military there are many operational watch officers who already understand their role as both consumers and producers and would be ideal for a targeted starting point in implementing such systems of systems.

It is important to note the fundamental potential of web feeds for transforming the DoD and US Military. They could potentially provide an unrivaled capability for system interoperability and agility. They are capable of sharing information unbounded by scale or form, allowing flows of information to be crafted to fit an organization's particular social and information network needs. Ideally, web feeds could provide the necessary capabilities to realize the hybrid Command and Control information network envisioned for an Information Age organization and allow for the right information to be shared with the right people at the right time.

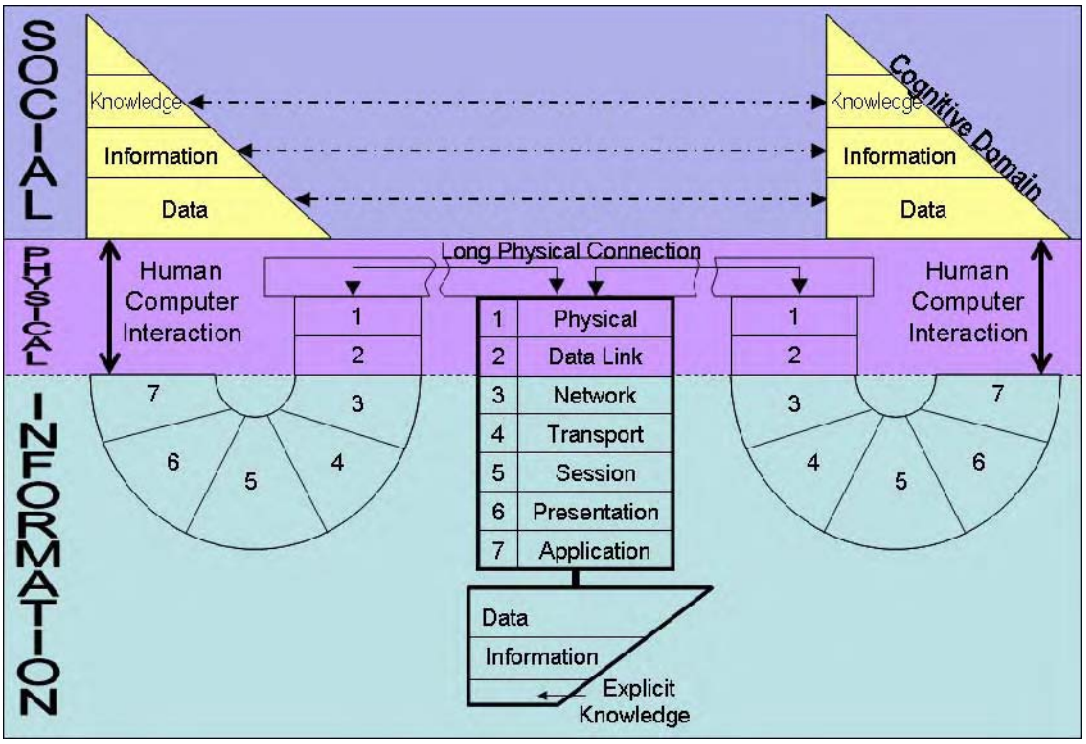


Figure 38. Two Users Sharing Information through an Information System.

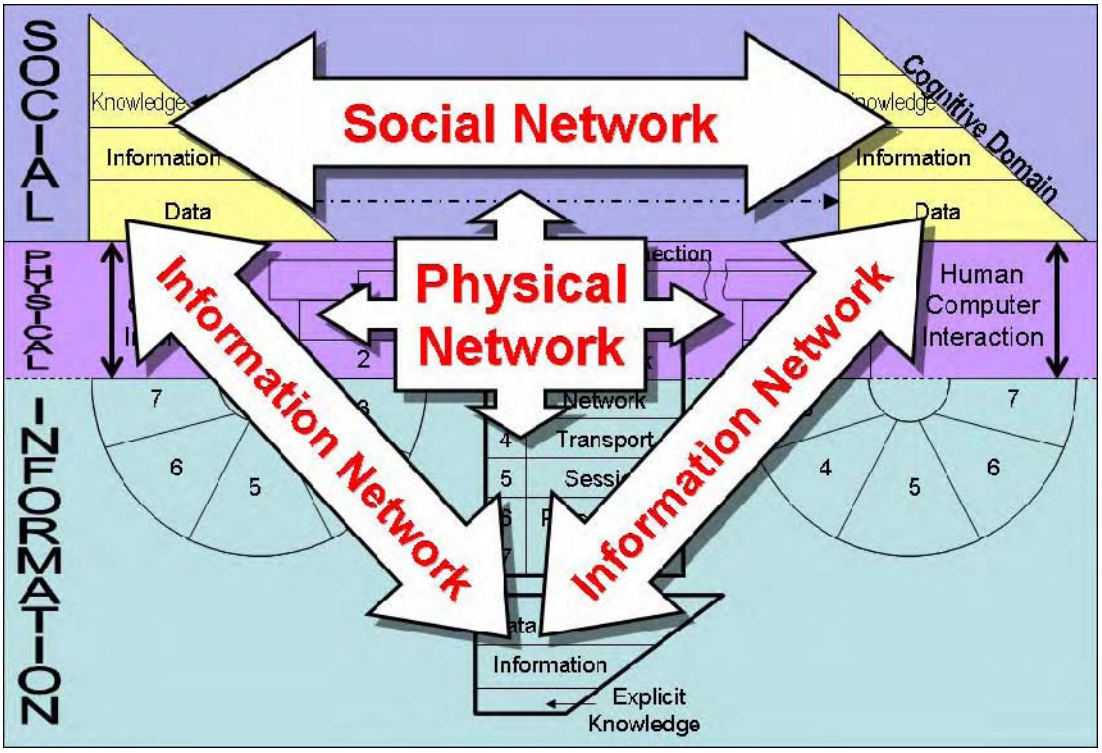


Figure 39. The Social, Physical, and Information Networks of a Notional Information Sharing Network.

The architecture presented in this thesis could be deployed in a multitude of variations to facilitate information flow a number of disparate organizations, however, it is not a "solution" for every problem. There is no single tool to solve all of the US Military's information sharing needs. There will always be a case where it might be better to make a phone call, send an email, or chat in a chatroom. As illustrated by Figures 38 and 39, this architecture is meant to facilitate sharing actionable information with unknown users in a timely manner, to supply a network of systems that are interoperable, and provide a foundation to hastily form information and social networks.

The emergent Internet technologies presented in this thesis are meant to provide a glimpse of how different constructs can be used in different circumstances to digitize information. The theories presented here were not meant to show a cookie-cutter method for building network-centric systems, or how to role out more portals, but to provide a concept of operations of how a network-centric environment could be facilitated through the integration of Web 2.0 constructs, the theories of Network-Centric Warfare, and the new generation of net-savvy service members.

B. FURTHER RESEARCH TOPICS

This thesis has only scratched the surface for this area of research and has hopefully laid a foundation for future research. There are several topics that need to be researched to help better facilitate NCOWFA-based systems.

1. Certification and Accreditation

One of the weaknesses of open-source systems is that there is sometimes no supporting company interested in assisting a system through the accreditation process. There needs to be research conducted to examine the best way of certifying and accrediting NCOWFA-based systems. The results of such research would compile a list of systems that have already completed the Defense Information Technology Security Certification and Accreditation Process (DITSCAP) process and been granted Authority To Operate (ATO), as well as generate a tailored template for developing a Systems Security Authorization Agreement (SSAA).

3. Organizational Applications

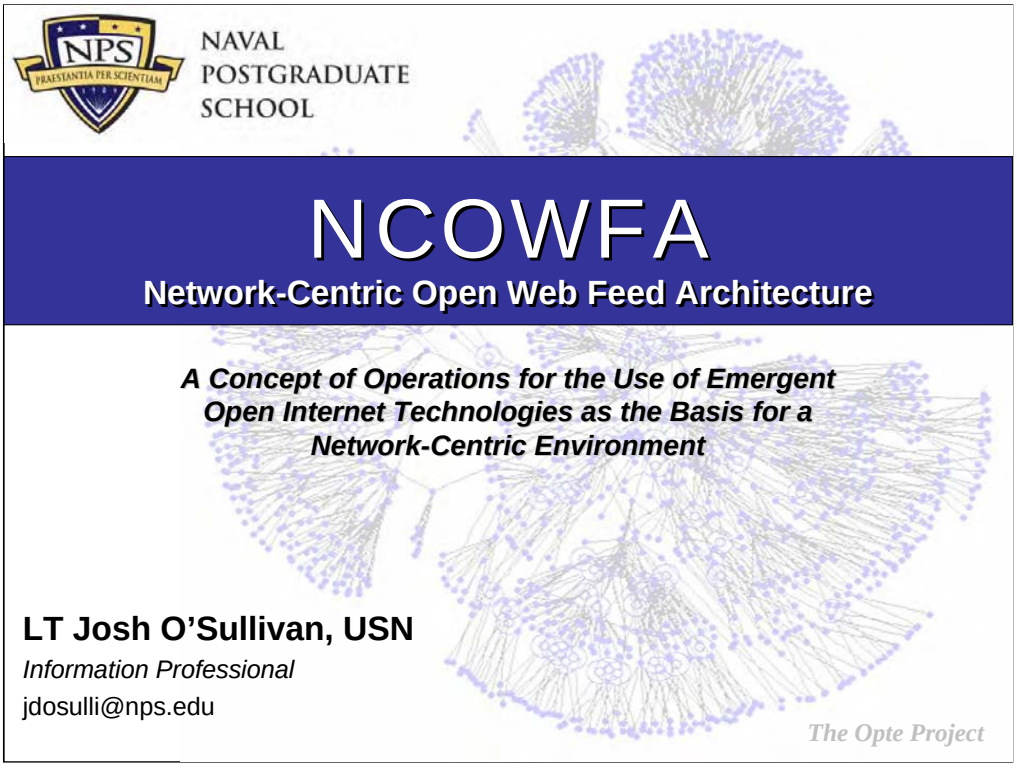
There are a number of potential applications for different organizations, with different people, process, and technology. There needs to be research conducted specific

to these organizations. Currently, there is a large amount of effort in sharing information in the Intelligence community, for Effects-Based Operations planning, and for building HA/DR Communities of Interest. Each of these areas would require a customized system of systems NCOWFA-based system with relevant processes to facilitate a network-centric environment in these areas.

4. Systems Development

The systems reviewed in this thesis were provided as an example to understand the general systems. There needs to be more research conducted as to their incorporation into a NCOWFA-based system, as well as determine metric of performance and metrics of effectiveness for comparing these different systems and their deployment in such circumstances. There needs to be additional research conducted in applying social computing aspects to these systems, such as users selecting favorite entries, tracking the most viewed content, and promulgating and displaying that information.

APPENDIX: (NCOWFA) NETWORK-CENTRIC OPEN WEB FEED ARCHITECTURE PRESENTATION

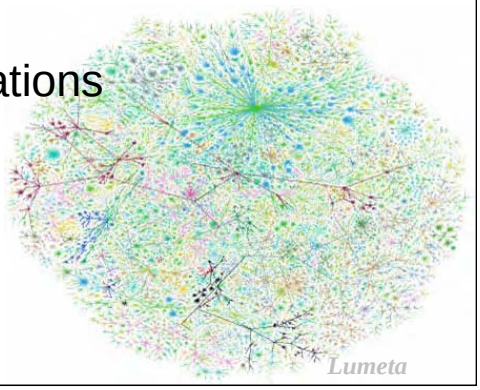


Good [Morning, Afternoon]. I am LT Josh O'Sullivan. I am a Navy Information Professional Officer stationed at the Naval Postgraduate School in the Information Warfare Curriculum. To provide you with a little bit of my background, I was commissioned through NROTC at Rensselaer Polytechnic Institute (RPI) after earning a BS in Computer Science & Psychology. My first several years in the US Navy included being stationed onboard USS ASHLAND (LSD 48) as the CICO and CDIO and Amphibious Squadron SIX (CPR 6) as the N3A (Asst Ops/Supporting Arms Coordinator). While at NPS I have deployed to Thailand after the Dec 2005 Tsunami in part of a joint Thai-US research in deploying wireless networks. Additionally, I deployed to Bay St. Louis and Waveland, MS in response to the destruction of Hurricane Katrina in September 2005.

Picture from http://bitcast-a.bitgravity.com/blyon/opte/maps/static/1068668226.Graphviz.2D.1884x1884.jpg

Outline

- My Frame of Reference
- Background
  - Modeling a Network-Centric Environment
  - A Hybrid Network
- The Concept of Operations
- Potential Applications

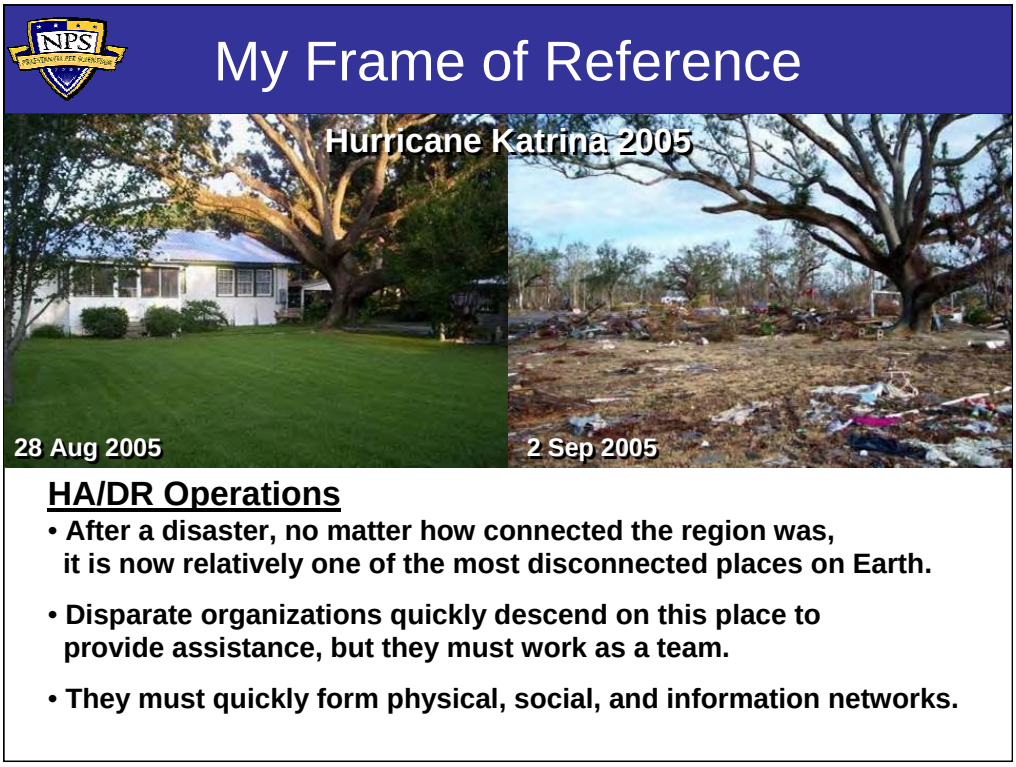


There are two main parts of this brief: theory and systems

This first portion I will be presenting is the theory, some background to understand the full ramifications of the systems.

The second portion will be the framing of the system of the whole, explanation of different notional subsystems, and examples of application and extensions.

Picture: http://www.lumeta.com/research/gallery/jun99-ip.gif



These pictures are of the same place a couple of days apart of a Navy Chief's home. HA/DR environments are the worst case for information sharing, because they have the most disparate organizations trying to work together in a disconnected, remote environment.

http://members.tripod.com/4christe/WavelandDamage

AZC(AW/NAC) Kimberly King's Home

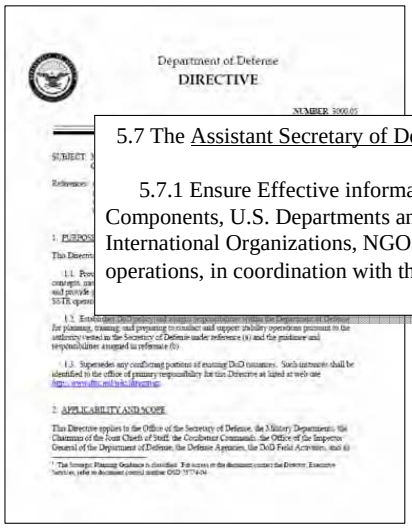
Hurricane Katrina Damage

Before: 28 Aug 2005
After: 2 Sep 2005

Waveland, MS

DoDD 3000.05

Military Support for Stability, Security, Transition, and Reconstruction (SSTR)



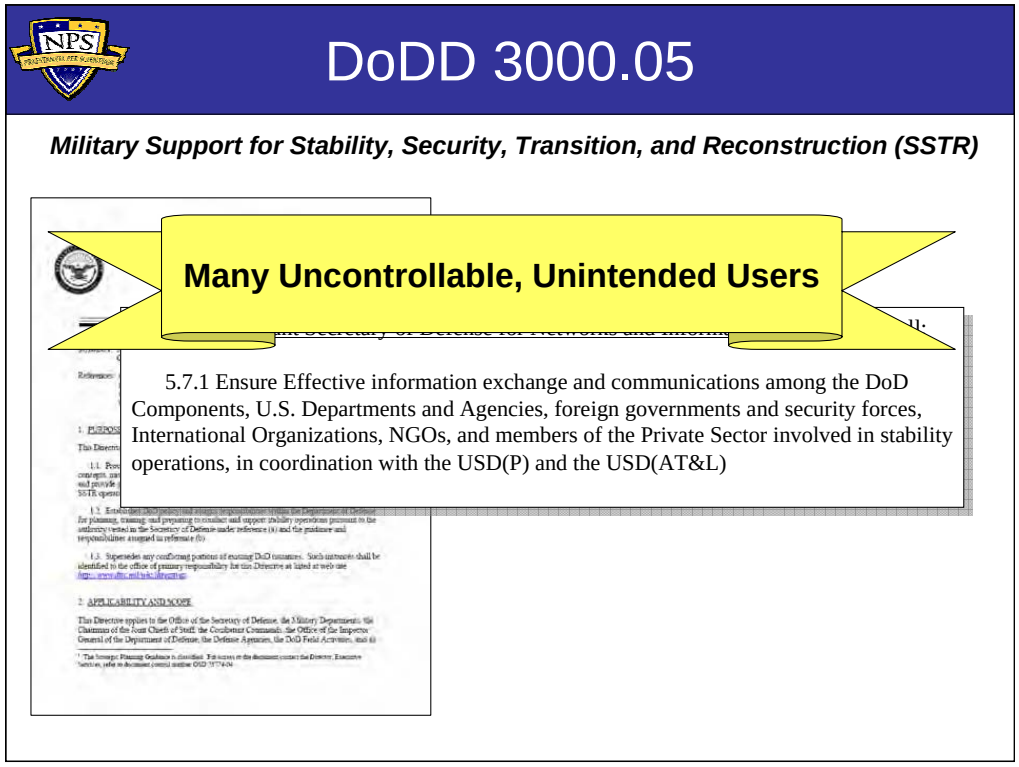
Department of Defense
DIRECTIVE

NUMBER 3000.05

5.7 The Assistant Secretary of Defense for Networks and Information Integration shall:

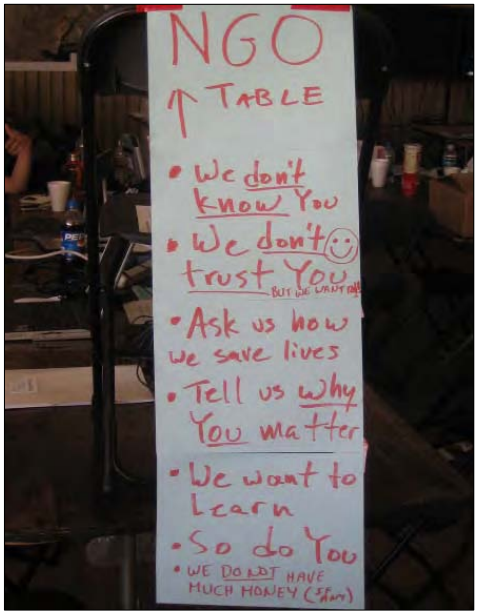
5.7.1 Ensure Effective information exchange and communications among the DoD Components, U.S. Departments and Agencies, foreign governments and security forces, International Organizations, NGOs, and members of the Private Sector involved in stability operations, in coordination with the USD(P) and the USD(AT&L)

Following the guidelines of DoDD 3000.05 the US Military can no longer ignore the problem of sharing information with other organizations.



The problem is real for DoD, because the requirement is to work with many "Uncontrollable, Unintended" Users. This translates to a requirement for systems that can work with nearly anyone.

Attributes for a System of Unintended Users



Strong Angel III HA/DR Exercise, August 2006

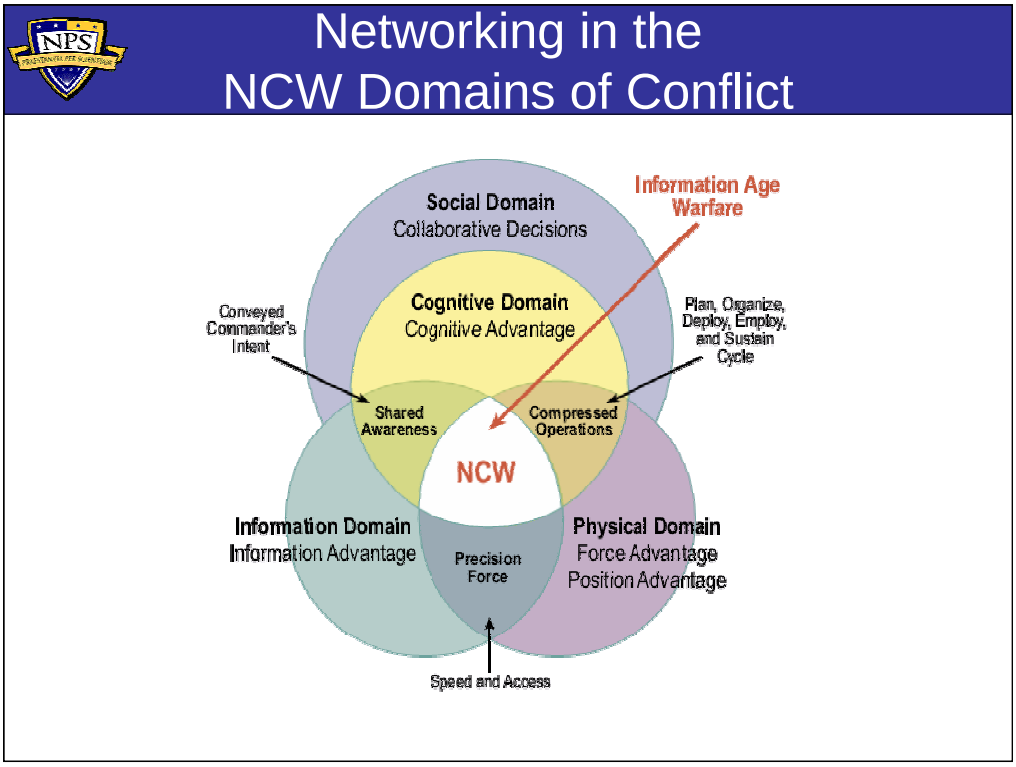
- **Trust**
  - Provide Environment for Passive Interaction
- **Sharing**
  - Easy Post and Smart Pull
- **Interoperability**
  - Open-Standards
  - Supporting Open-Source Systems
- **Agility**
  - Web Browsers
  - Web Feeds
  - Dynamic Information Flows

JP 6-0 describes 4 key characteristics of Joint Communication Systems as Trust, Sharing, Interoperability, and Agility. Looking at an HA/DR environment, the worst case scenario, the availability of trust is minimal, while the need for the other three are at a maximum. In essence a system designed for this environment is designed for sharing information with unknown users. My approach to this system is to develop an environment for passive interaction, where information is shared through interconnected "feeds" that can move information to people who need it regardless of who they know. The interface for such an environment must be found on most common types of computer operating systems, such as web browsers and web feeds. To support the interoperability of such systems between different organizations, these systems must support open-standards to maximize the acceptability of feed format. If a system does not support open standards, then the system is in actuality a very large, fully-connected, but non-network-centric stovepipe. Additionally, these open-standard systems must be supported by open source systems that can be easily given to other organizations without the need for license management. Content must be quickly digitized and accessible in such an environment, so there is an additional need for a "post and smart pull" type system, where users can quickly post their content and have it promulgate through the system quickly, by being efficiently pulled by users and system that need it.

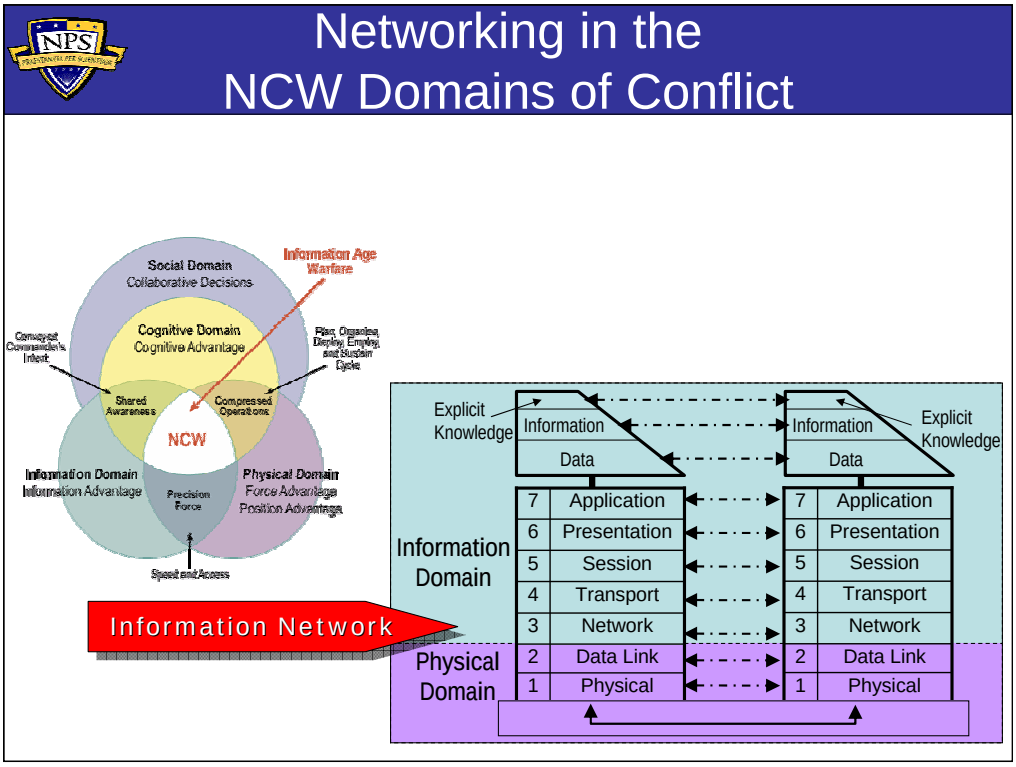
During my deployment in support of Hurricane Katrina, my group was working to establish wireless mesh networks in the area. I was sitting in a the WAL-MART parking lot talking with the Communications Officer from a Florida Relief Team. We noted how everyone had their “own Satellite dish”, everyone was able to go on the Internet and check their email. But no one could talk to each other, no could share information, no one knew who to talk to.

Hurricane Katrina Relief Operations, August-September 2005

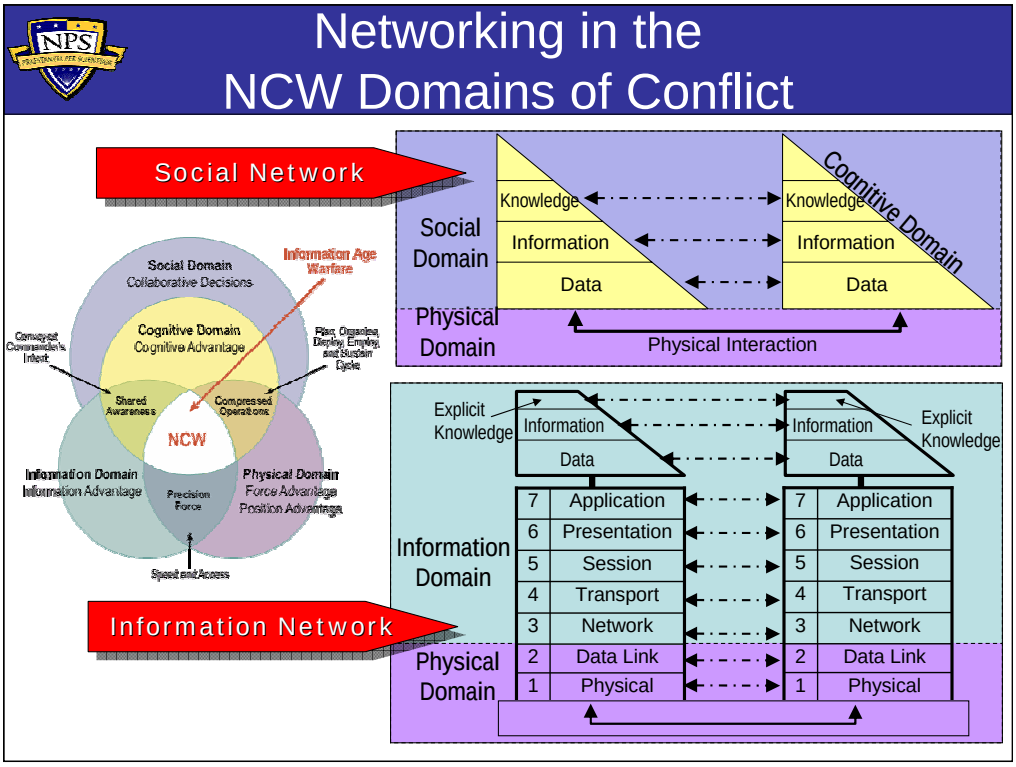
The take away from my conversation with the Florida CommO was that although everyone was able to establish a physical network to be able to send zeroes and ones to anyone else. There was no social or information network to know who to share information with or for information to flow.



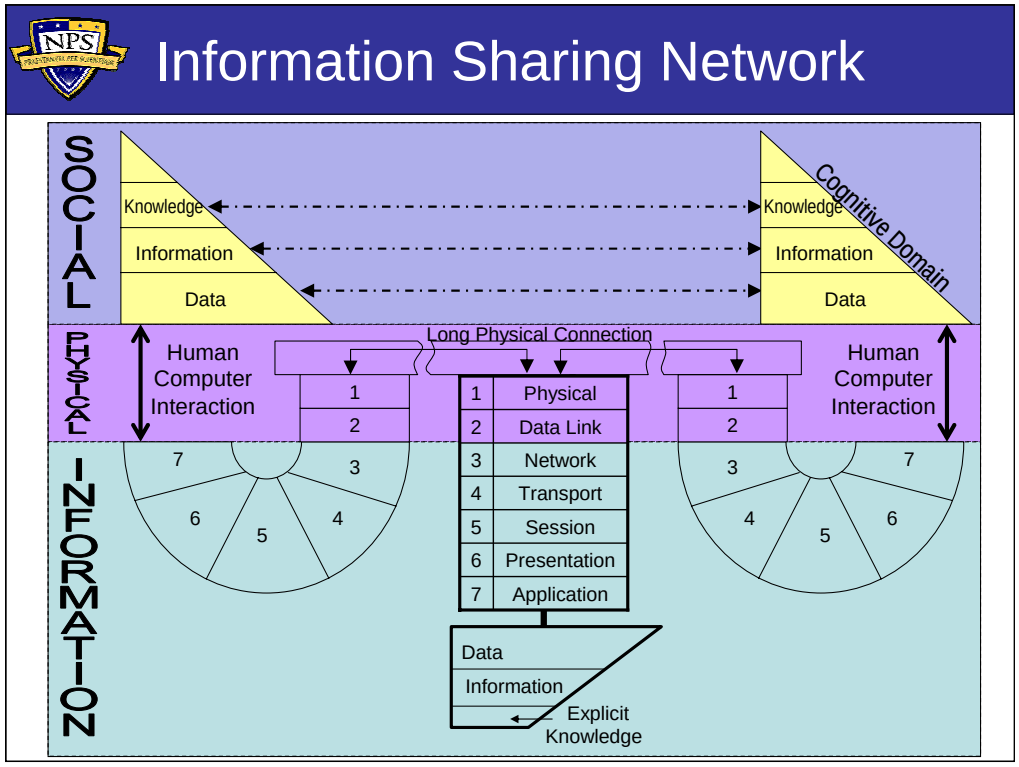
The problem we noticed at the WAL-MART EOC was that no one was looking at the problem holistically (i.e. looking at the problem from the point of all the domains and not just as a technical solution). Unfortunately, this diagram is not a good model for illustrating networks.



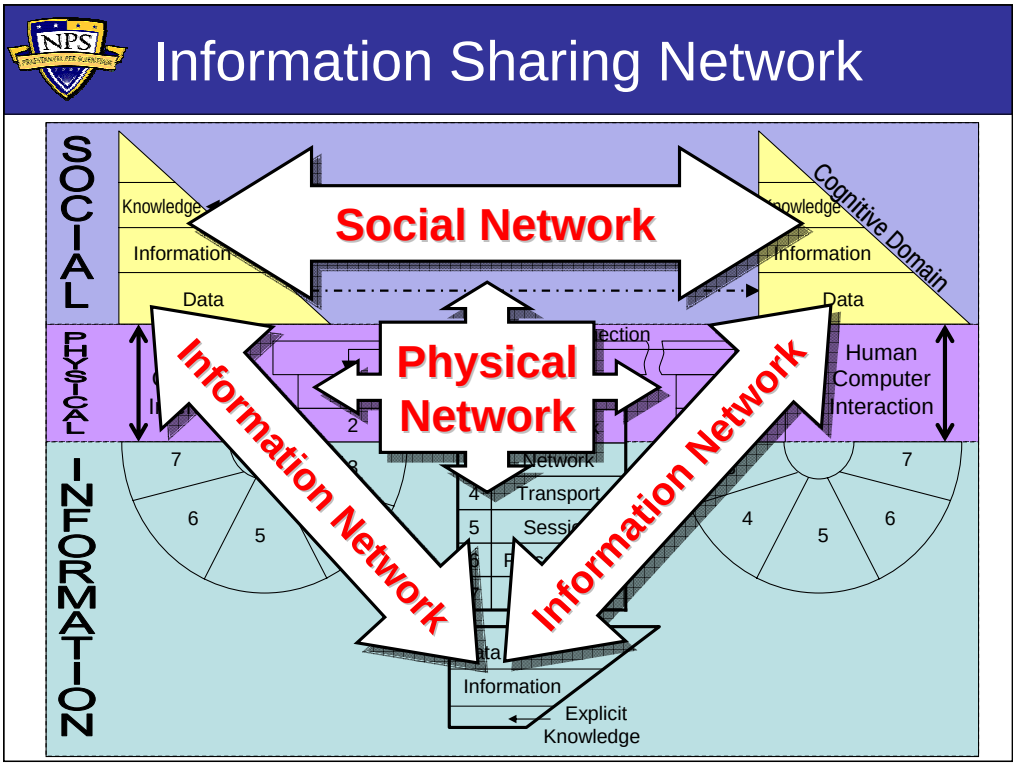
Combining Dr. Mark Nissen's Knowledge Hierarchy and the OSI Network Model, a representation can be made of an Information Network. Where the Physical and Information Domains are separated between Layer 2 (Data Link Layer) and Layer 3 (Network Layer). At Layer 3 the packet of data is addressed to a specific computer (the gateway of the Information Domain) and not a particular route in the physical telecommunications network). Additionally, there are other layers above Layer 7 where the Data, Information, or Explicit Knowledge is stored in a container (such as the Hard Drive of a computer). This is similar to Dr. Nissen's Knowledge Hierarchy which is fully representative of the Cognitive Domain, except in a non-cognitive container, the system can arguably only contain Explicit Knowledge. With this model one could diagram an Information and Physical network together.



Extending the model of the Information Network, a Social Network can be diagramed with the use of Dr. Nissen's Knowledge Hierarchy to represent the Cognitive Domain. The Cognitive Domain is based in the Social Domain, but can only exchange Data, Information, or Knowledge through some kind of physical interaction. This model can be used to diagram Social Networks that exist in the Social, Cognitive, and Physical Domains.

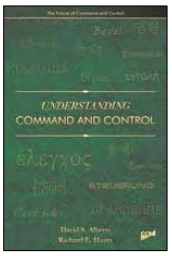


Combining the two models together a complete model can be used, for example two users sharing Explicit Knowledge through the use of an Information System (such as a wiki or a blog).



Thus with this model Social, Physical and Information Networks can be diagramed through all four Domains of Conflict in one cohesive picture. By viewing information exchange in this model, it is apparent the problem that was observed in the WAL-MART EOC of Waveland, MS.

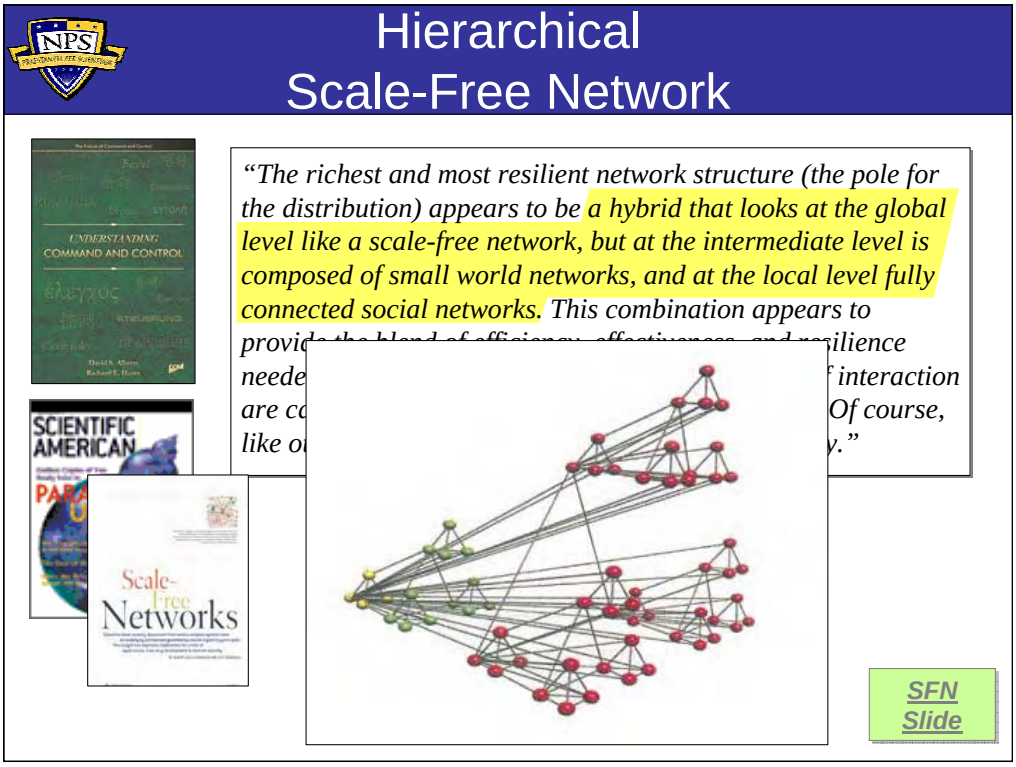
What Information Networks are We Creating?



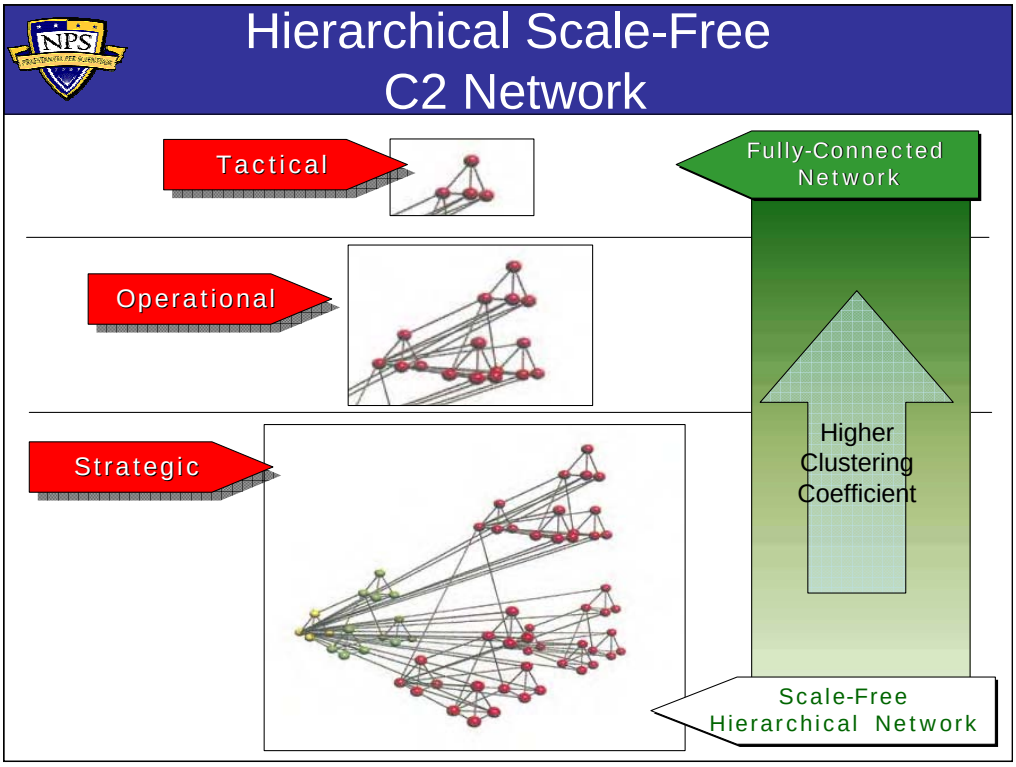
"The richest and most resilient network structure (the pole for the distribution) appears to be a hybrid that looks at the global level like a scale-free network, but at the intermediate level is composed of small world networks, and at the local level fully connected social networks. This combination appears to provide the blend of efficiency, effectiveness, and resilience needed for large-scale enterprises. These patterns of interaction are capable of becoming complex adaptive systems. Of course, like other ideal types, this hybrid does not exist today."

SFN Slide

In terms of Information Sharing Networks in the Information Age, Dr. Alberts and Dr. Hayes in their most recent book, *Understanding Command and Control, describes a theoretical network that they say although is ideal, does not currently exist… however…*



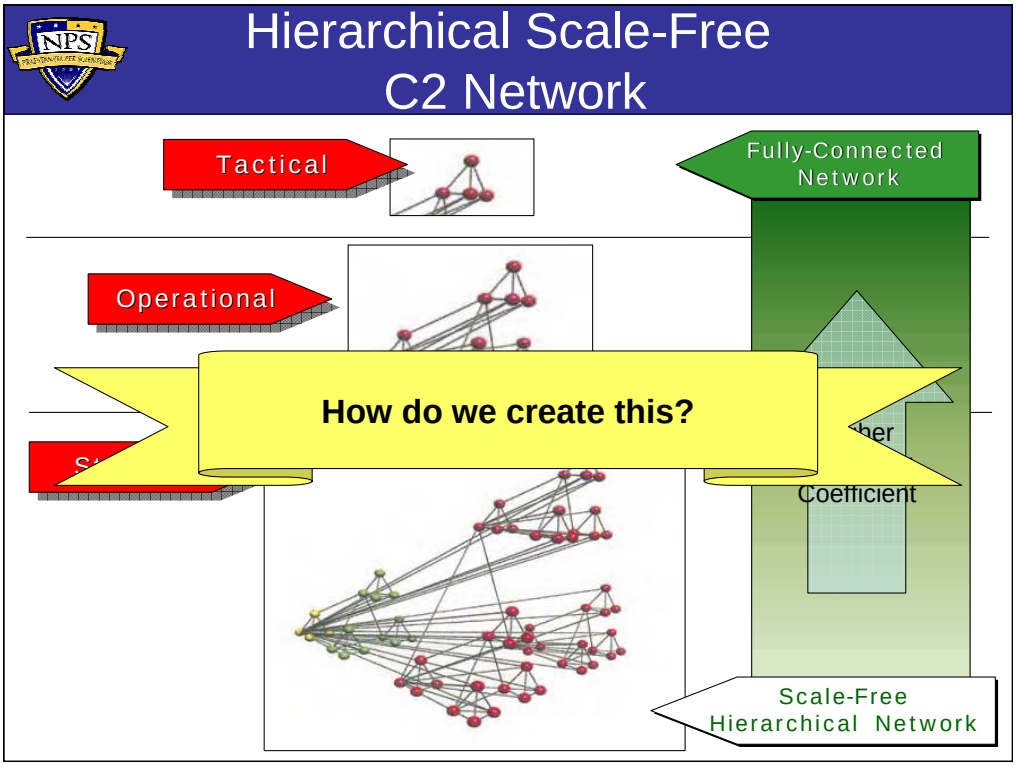
Dr. Barabasi has developed a concept called a hierarchical scale free network built on the basis of modularity that potentially diagrams the network Dr Alberts and Dr Hayes describes.

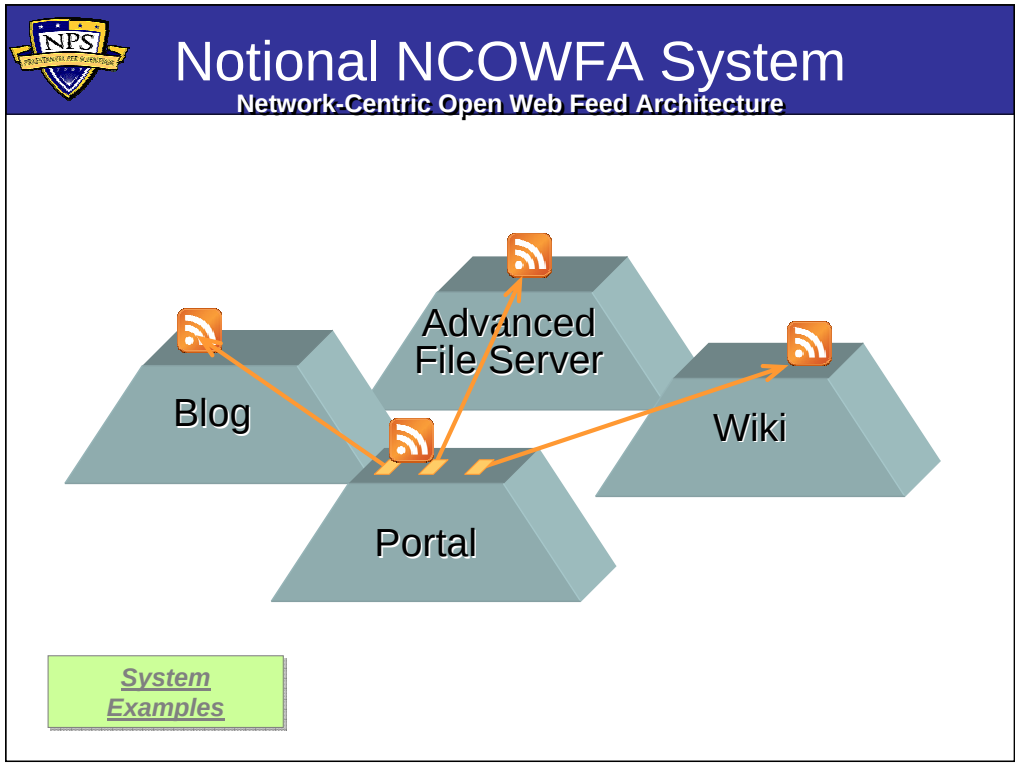


This theoretical network is fully connected at the tactical [local] level (such as a ship's watch team), at the operational [intermediate] level clusters of fully connected small worlds can be observed (such as a squadron of ships and a command staff), at the strategic [operational] level a scale free network can be observed where there are a number of clusters interconnected by hubs with many connections and long connection lengths (such as a Fleet of ships, where some info goes directly from a ship to the Fleet staff). This type of information flow might seem similar to the traditional military hierarchical organizational structure, however, in this case the chain of command is getting "jumped."

This is the necessary structure, however, during HA/DR operations as a model to describes information flow between the systems of different organizations, where each organization will be clustered around their information systems which should be interlinked with other organization's information systems. As the network of organizations gets bigger and bigger, the information network broadly looks more like a scale-free network.

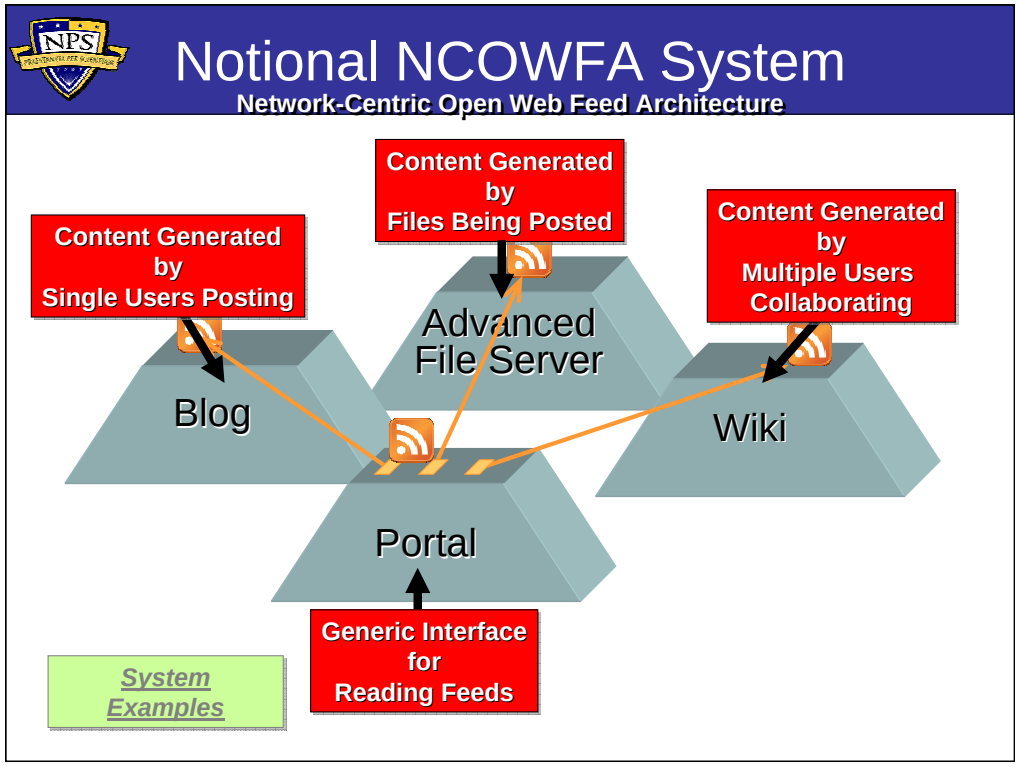
Hierarchical Scale-Free C2 Network



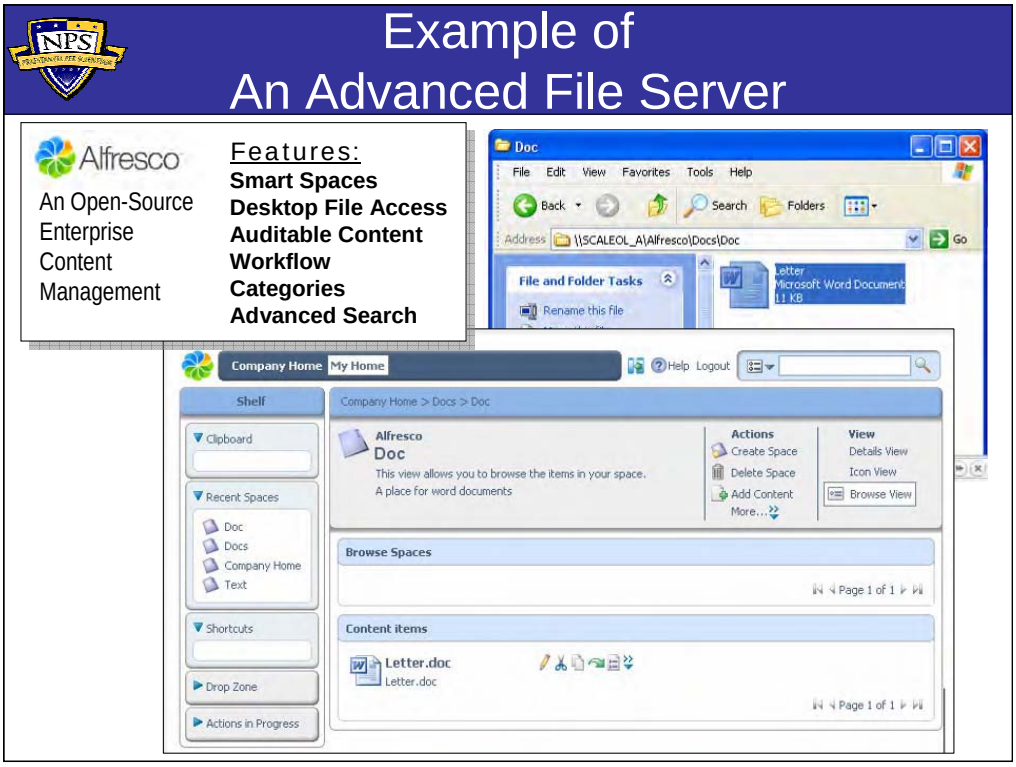


This is a notional representation of an information system a “portal” with other systems connected to it. These systems may be integrated or separate systems connected by some type of connection. The basis of my architecture is the use of web feeds for the open-standard format of connecting these different systems. The power of using web feeds, provides interoperability and agility to the point of being able to build the theoretical networks suggested by Dr. Alberts and Dr. Hayes.

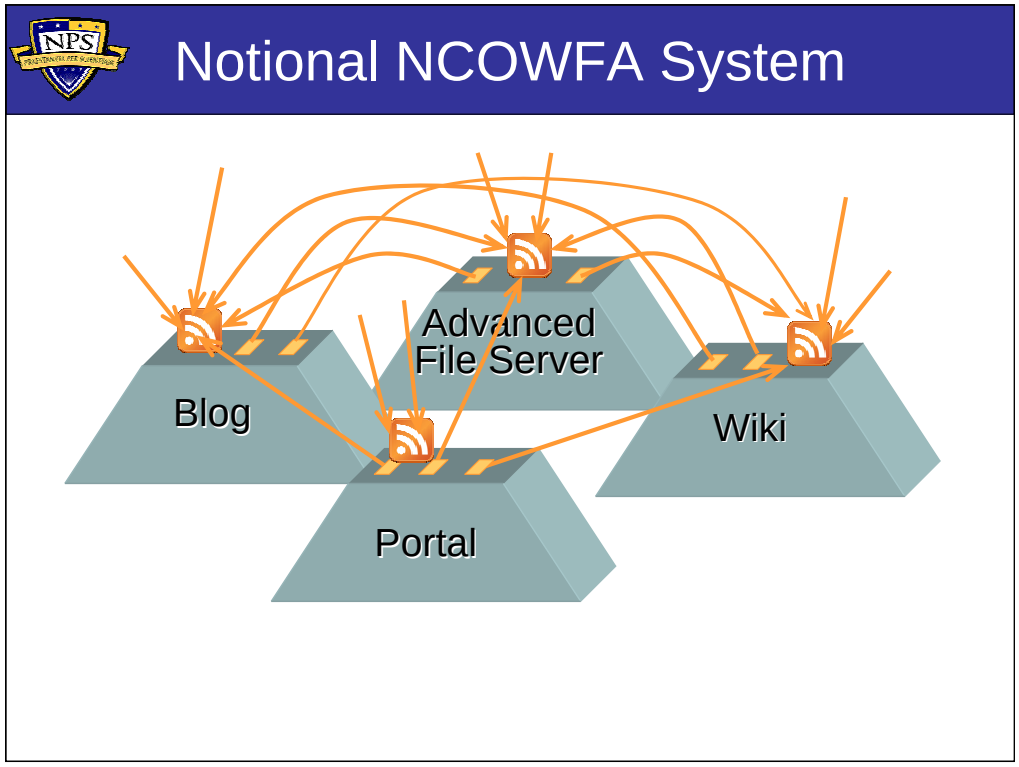
Presumably everyone is familiar with Web Feeds RSS and ATOM have been working their way into the mainstream through podcasting and other syndication constructs. If not follow the “Web Feeds” link in the upper right hand corner.



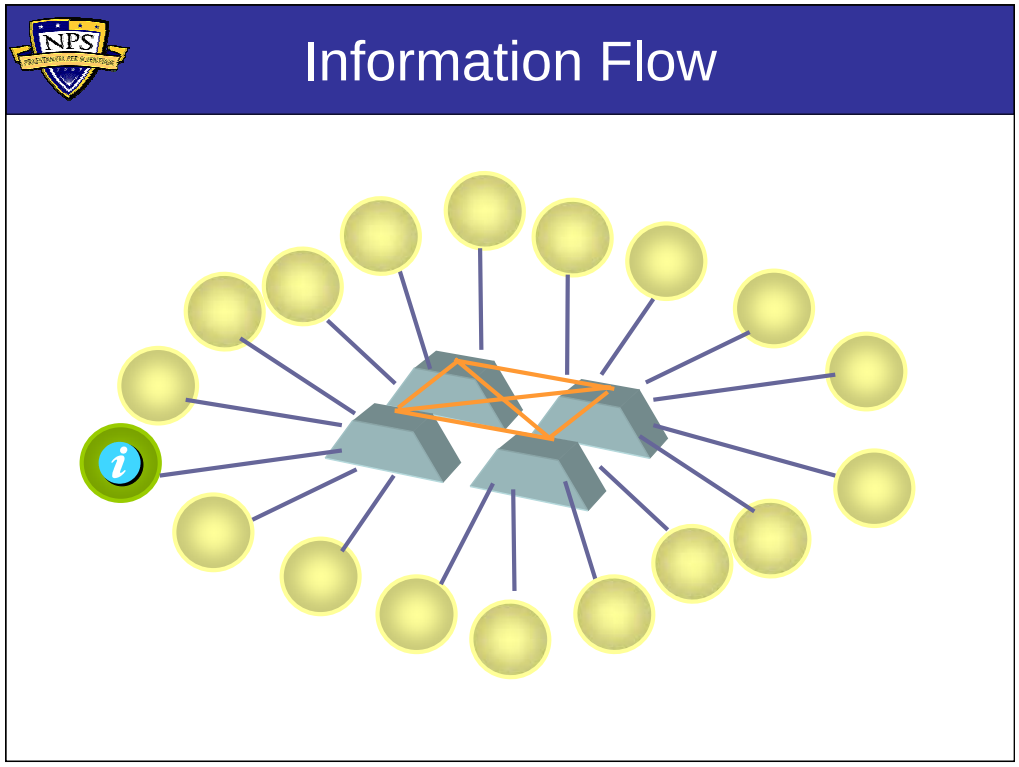
The notional systems presented in this system provide general ways of managing and developing content. For examples of the different systems following the link “System Examples.”



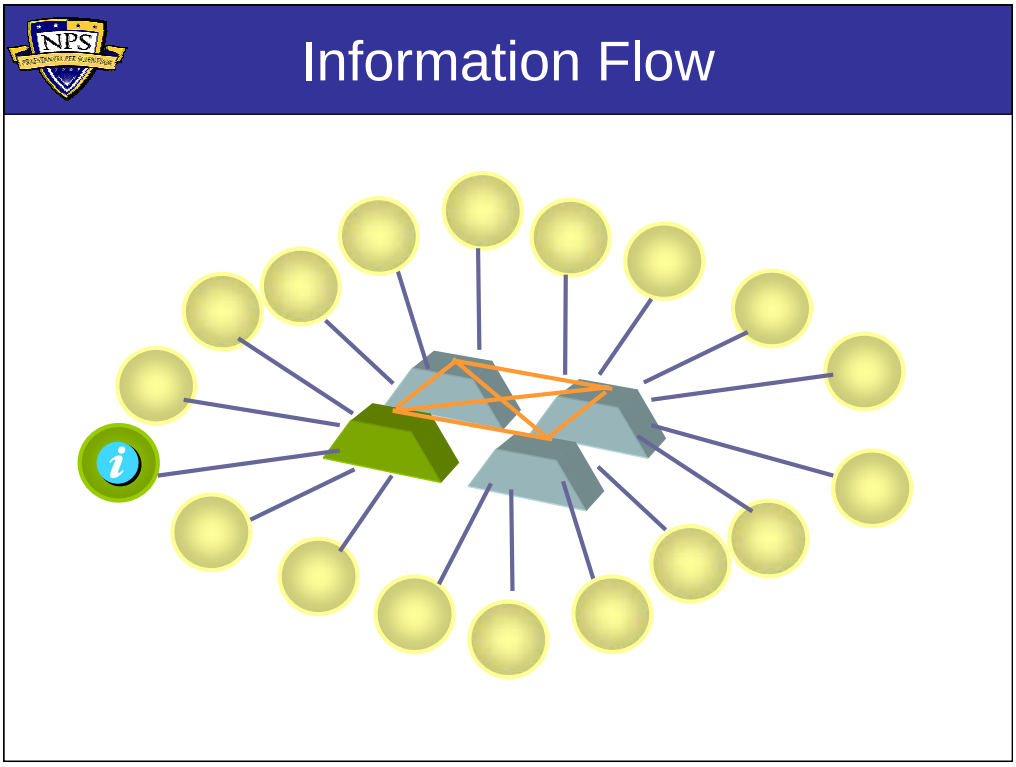
Advanced File Servers is something that most people are not familiar with as it is an emerging construct. Think of it as a Networked Share Drive on steroids. For example Alfresco was introduced in later 2004. It provides share drives with automation and web access, allowing for users to simply drag and drop content on their desktop and then the files can be indexed for assigning metadata or have rules executed for conversion or movement in workflows.



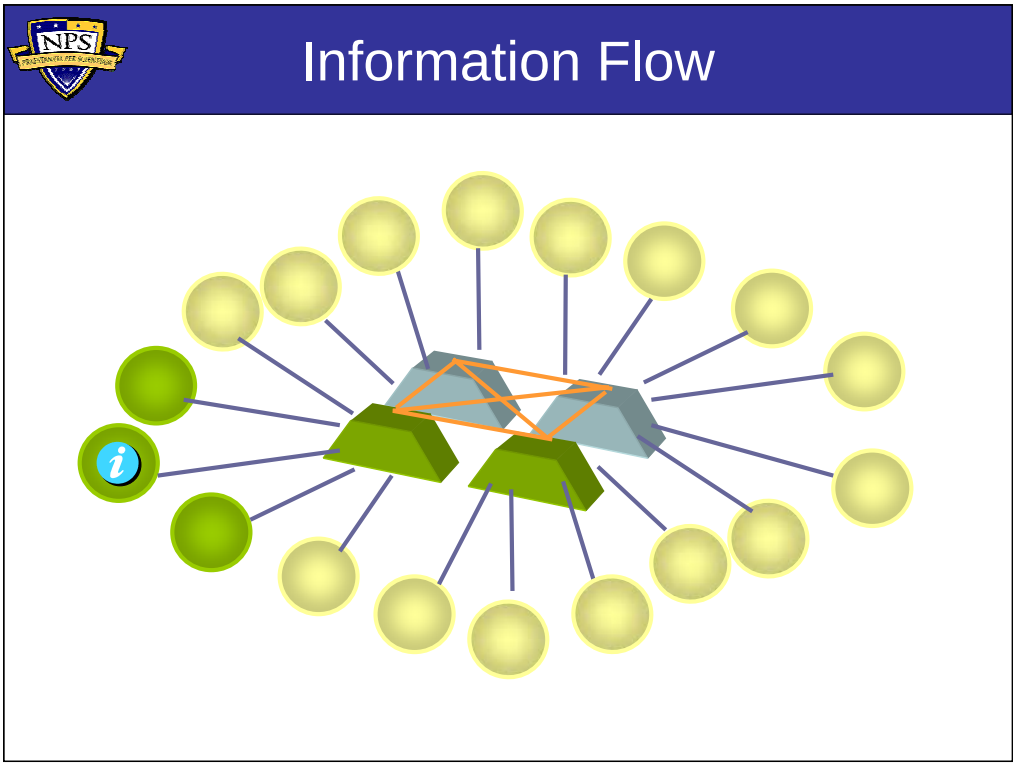
This notional system in this architecture, however, can be far more robustly interconnected with other systems through the use of web feeds… For example …



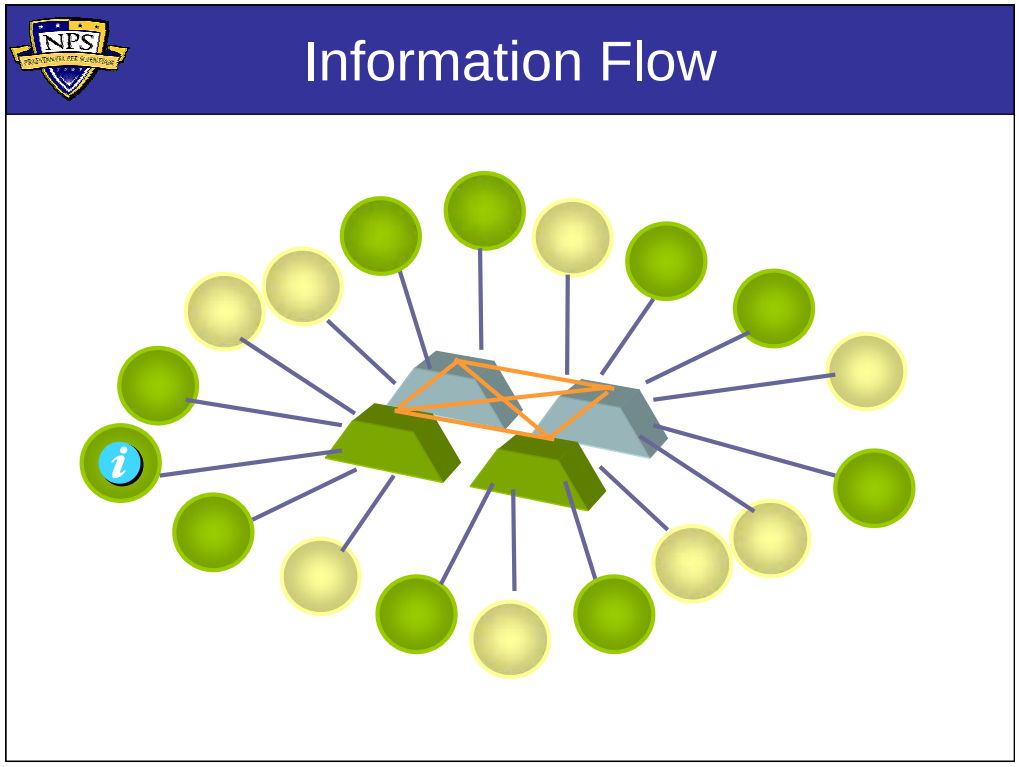
As an example of information flowing through a network of NCOWFA based systems. Imagine a watch stander has a bit of information (perhaps the load manifest of a departing helicopter), the report of the helicopter departure is recorded to the watch stander's blog.



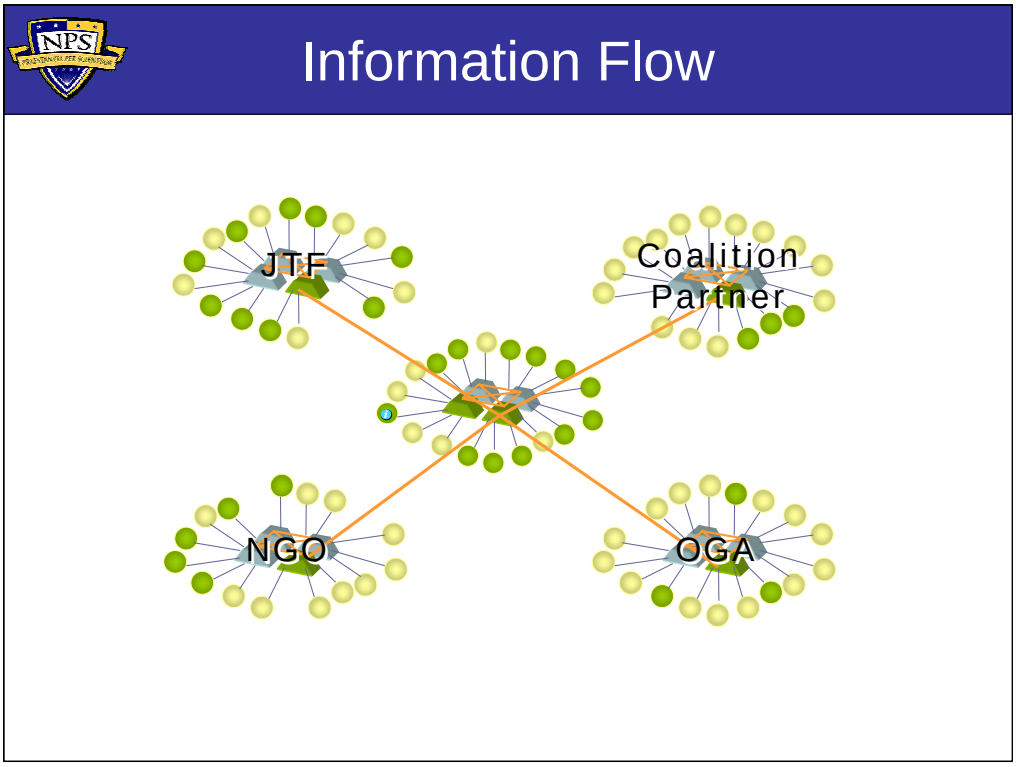
The watch stander posts a report to the blog, which monitored by other watch standers.



The watch stander's blog is monitored by other watch standers and other systems through web feeds of the watch stander's blog.

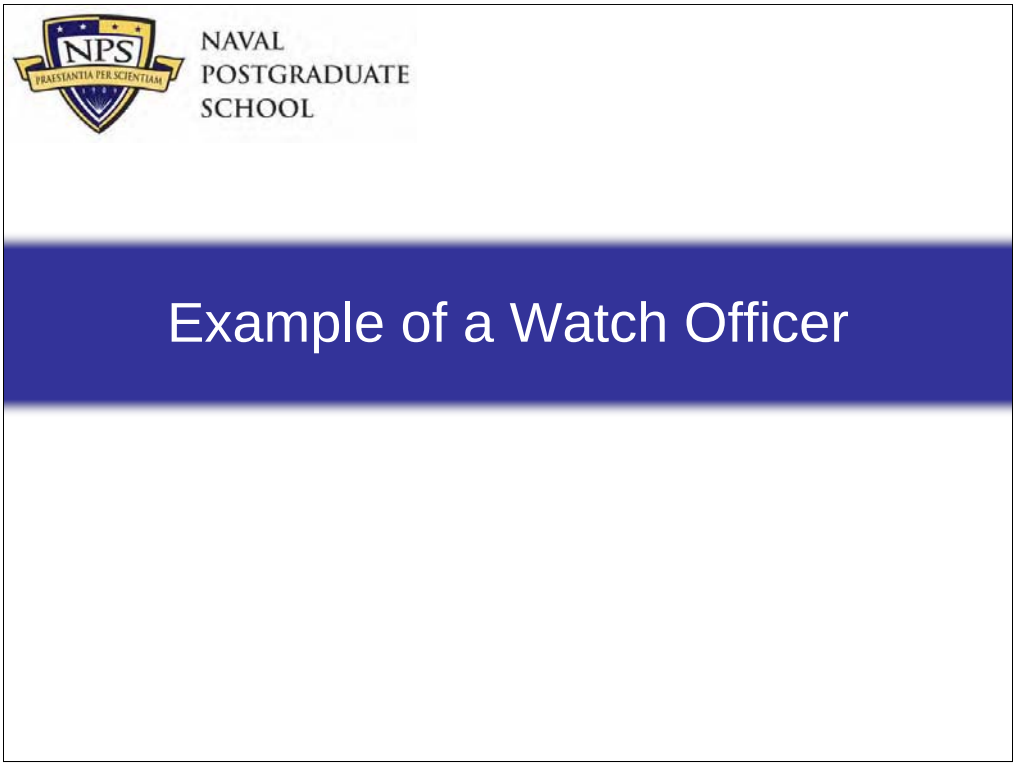


The post from the watch stander's blog is promulgated by web feeds through out his command through another feed that monitors current operations. Users did not need to watch the particular watch stander's blog to get the information smartly pulled for them that a helicopter had recently departed or the link to the flight's manifest. This feed and other feeds can promulgate to other organizations that monitor this organization's feeds.



The watch stander's feed and other feeds can promulgate to other organizations that monitor the organization's feeds.

Note: OGA is in reference to Other Government Agencies and Organizations (Intelligence organizations or otherwise). This set of slides demonstrates how information can move through web feeds internally and externally of organizations allowing for information to be shared with users unknown to the poster who have an interest in the information being posted.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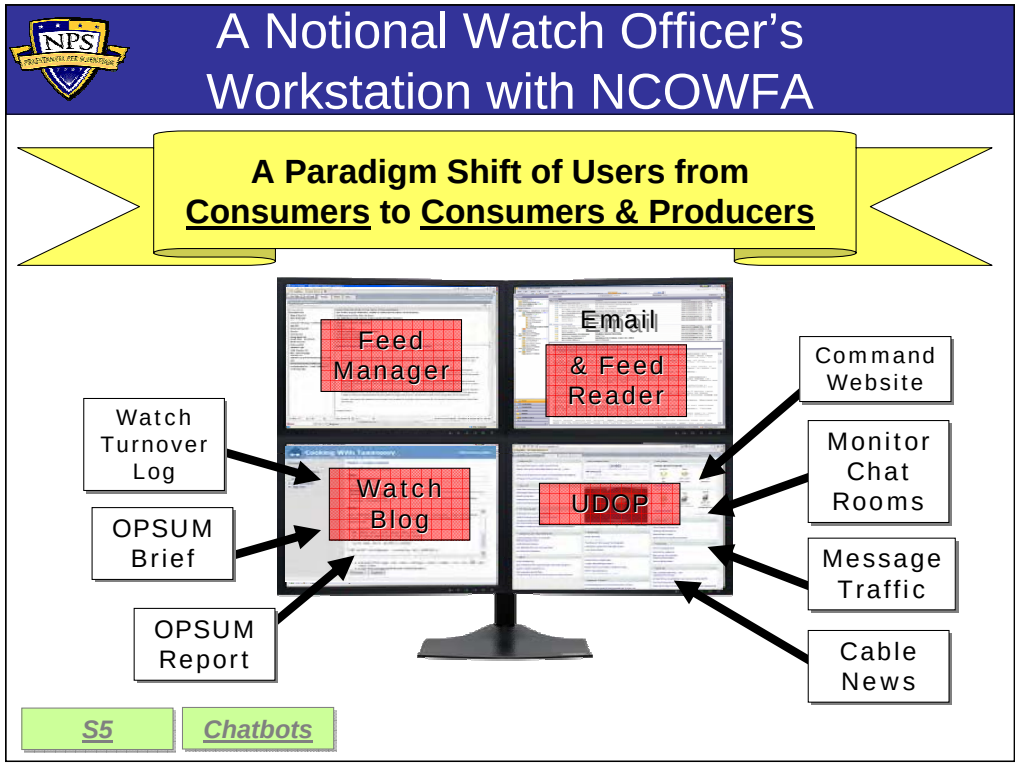
Example of a Watch Officer

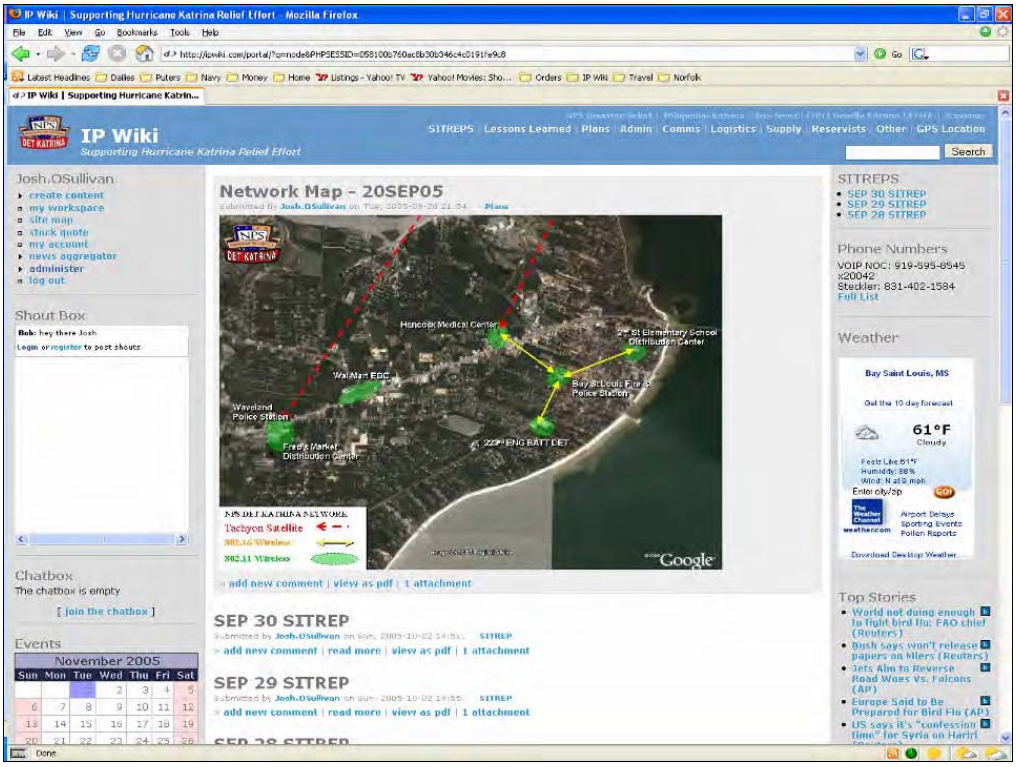
All kidding aside, one of the current solutions I have seen to mitigate information overload is to give the watch stander another screen to watch and work on. At what point does this become too much?

While observing a watch stander, I noted that they were doing a lot of redundant work. They had to maintain a paper log, then write the same information into a word document, then write the same information into a PowerPoint file, then summarize the information to another word document to summarize everything else, so that every who was supposed to read and review the first three could be aware of its content. Although the watch stander works hard to consume information and thus gain and maintain situational awareness, the watch stander is not really producing information efficiently, nor adding content to an information network. The watch stander is clogging a number of email and file servers with redundant and dated material.

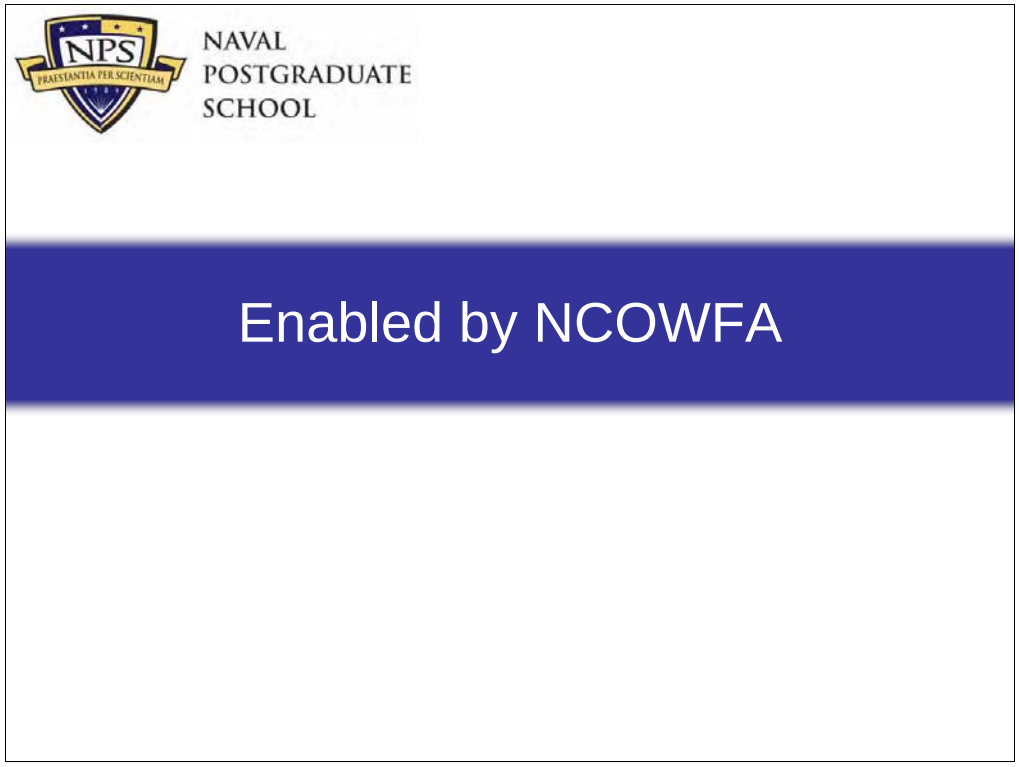


If instead the watch stander was monitoring the feeds of his subordinates, contemporaries, and superiors, the watch stander would be able to more efficiently maintain situational awareness. Additionally, the watch stander would be able to mark items in feed for a new feed of important information relevant to his command. This information could be linked to and annotated by the watch stander's blog, which is instantly available for others to read, instead of waiting for the turnover email. Additionally, a format called S5 could be used to change the formatting of the blog or a web page that combines several command blogs, such that a brief can be generated in near real-time and presenting through a web browser. It is key to the not the paradigm shift is that more and more users become both consumers and producers of information, not just consumers.

Here is an example of a User Defined Operational Picture (UDOP), where the users is monitoring several defined feeds and portlets that provide a customized picture.



This is an example of a prototype system I deployed as the Knowledge Manager of the NPS Detachment for Hurricane Katrina. The prototype was a system called Drupal that allowed for users to post contents as a blog entry or general wiki entry. Additionally, the system would read web feeds such as media articles with the keywords of “Katrina” and “NPS,” as well as provide web feeds for contents such as the Detachment’s Daily SITREP.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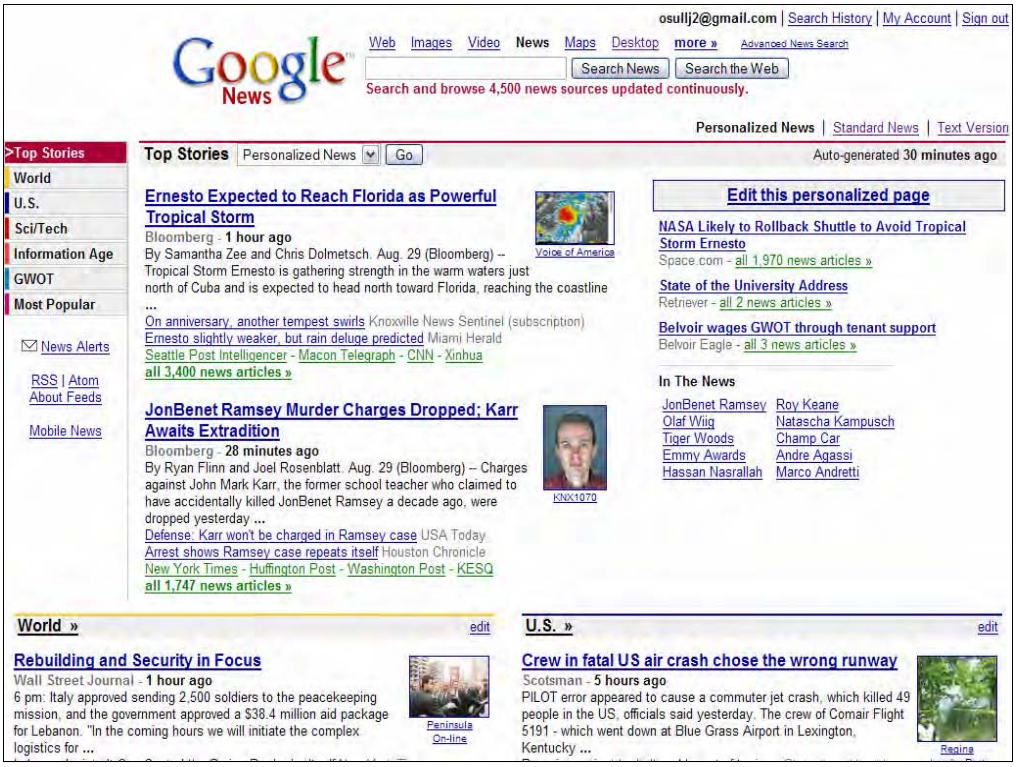
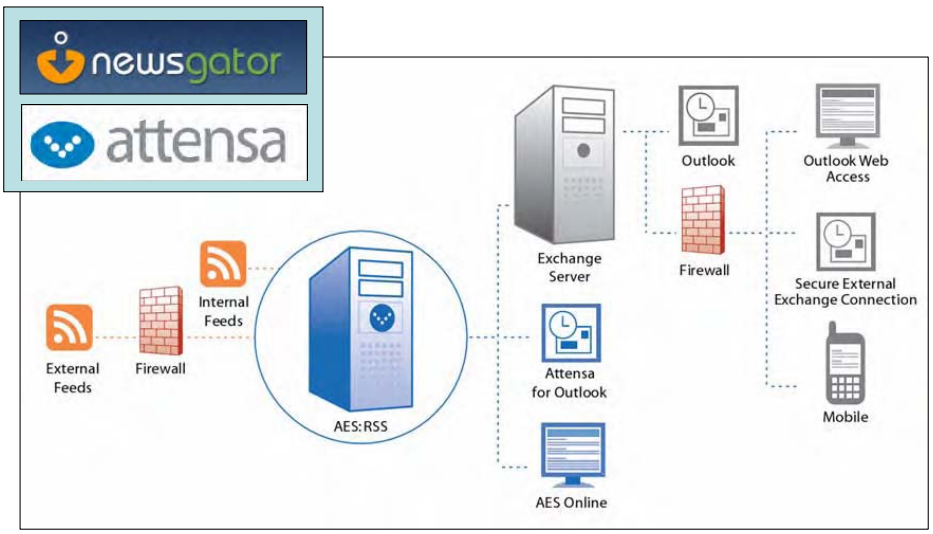
Enabled by NCOWFA



Google News is an example of a web feed server that takes in many feeds (such as Google News's 4,500 sources) and combines them into customized new feeds, such as ones based off of keyword searches, categories, dates, regions, etc.

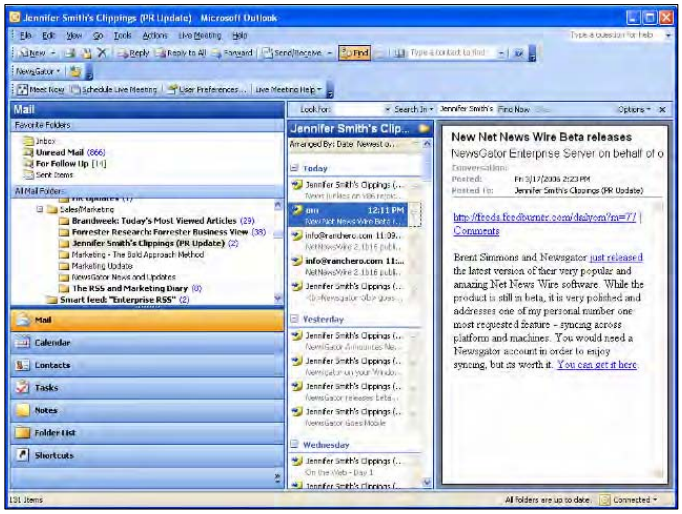
Web Feed Server (An Enabler)



Graphic for NewsGattor Attensa

Two commercial systems available to be used for Enterprise Web Feed Servers are NewsGator and Attensa.

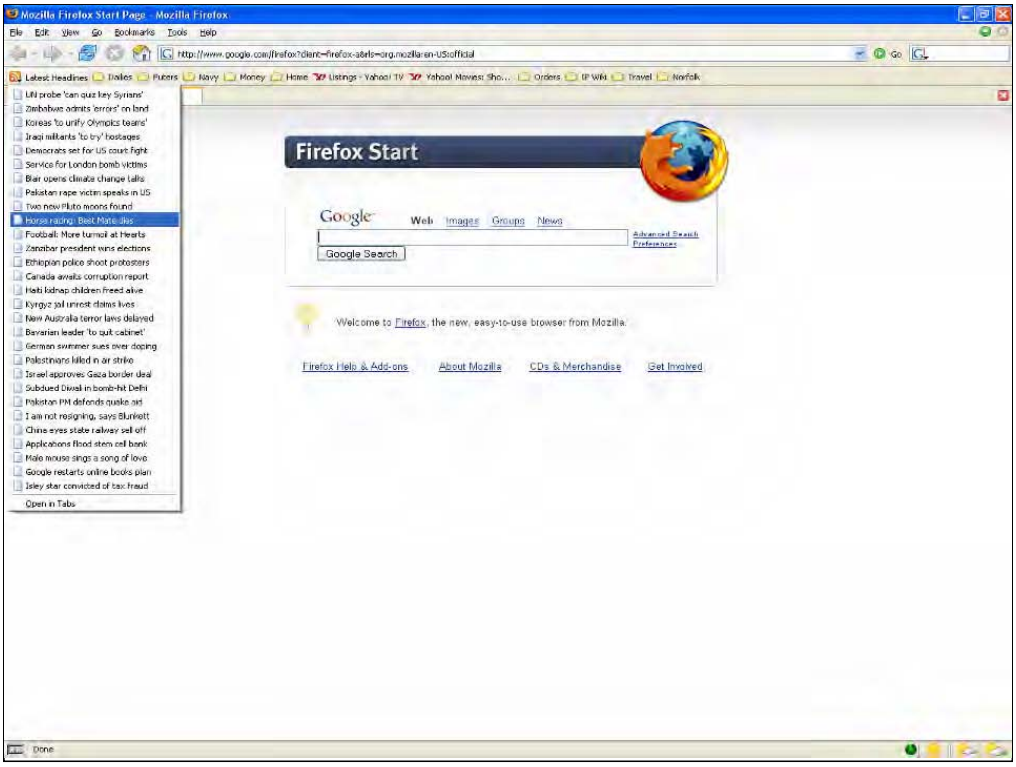
Other Ways of Reading Web Feeds



There are many ways of reading web feeds:

-Through Microsoft Outlook with a plug in

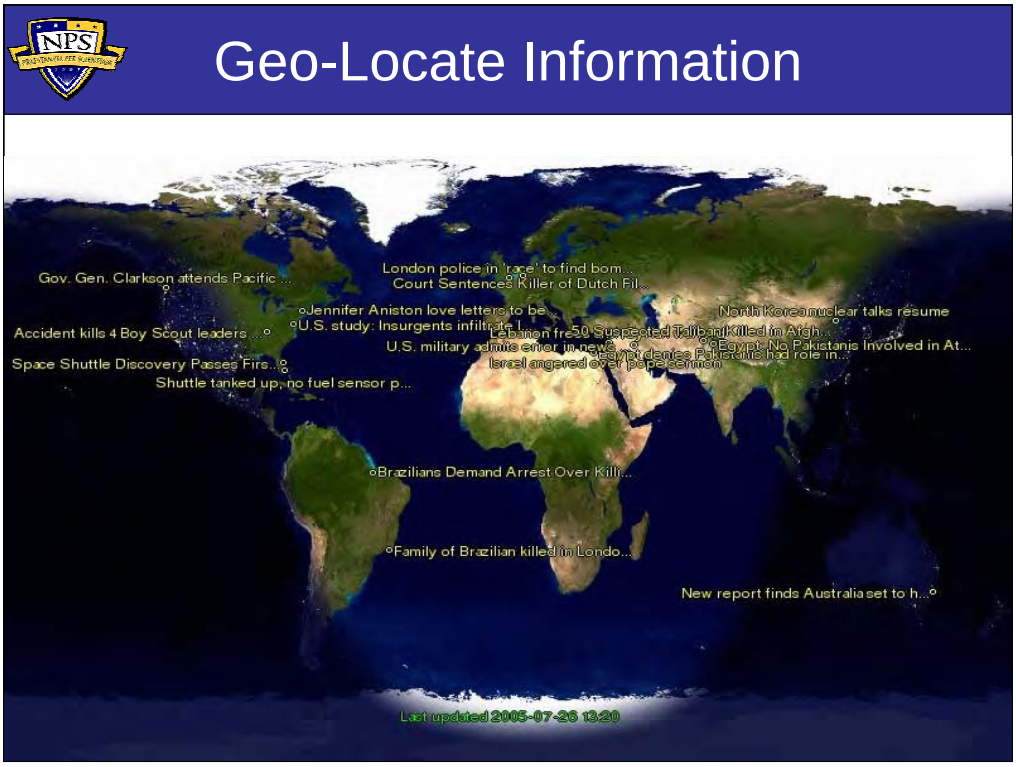
-Through a scrolling toolbar



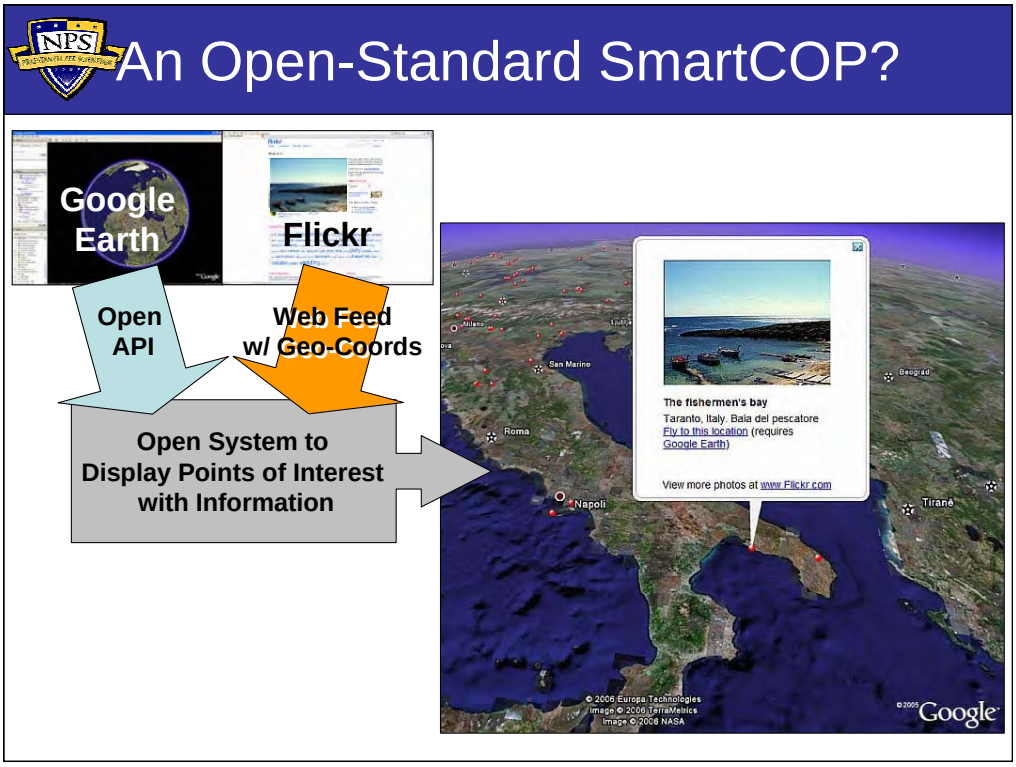
Or one can read feeds through a web browser such as Mozilla Firefox or Microsoft Internet Explorer 7

There is also an emergence of visualization techniques, such as Tag Clouds. Tag Clouds display a list of keywords. The keywords grow based their frequency of occurrence. This could be expanded as the frequency of keywords in searches, content viewed, contented posted, etc.

One example of a military application is the monitoring feeds of Equipment Casualty Reports for most common problems or locations of calls for Fires.



There is also the emergence of Geo-blogging where GPS coordinates are included in elements of feeds.



One possible use of this concept of geo-blogging is to use the same setup to develop and open SmartCOP (Common Operational Picture) that also links to a wiki that users can add additional information about a particular contact.

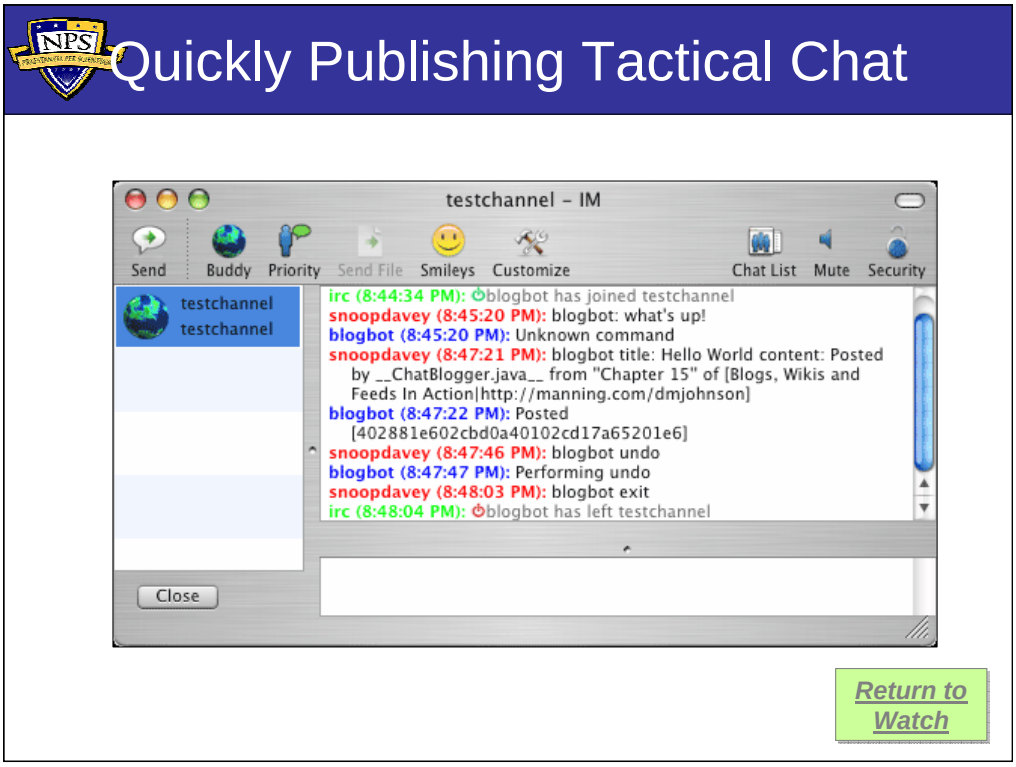
A White Force Tracking System?

Another example is from an article that recently appeared in a Popular Science article (Todras-Whitehill, Ethan. 2006. Track anyone with A cell. Popular Science 268, (5) (May): 86.)

where users can geo-blog from their cell phone, recording messages, posting pictures or text messages, and provide tracking information from their cell phone.

A Mini-Knowledge Wall?

Perhaps UDOPs can be displayed on senior personnel's wall-mounted plasma screens displaying current information from feeds they are interested in.



An example of using chatbots to tie NCOWFA based systems to tactical chat rooms, allowing for personnel to post content from chat rooms, or for an automated program to watch for keywords to broadcast, respond to user queries, or to make announcements from monitored feeds.

Example:

http://rollerweblogger.org/page/roller?entry=wiki_bloggin_chatbot_in_action

Final note. Why does the US government need to host all of these systems. Since open-standards are supported, current ly available systems are possibly available that could provide the same functionalities in certain environments. We can monitor what NGOs are doing by simply monitoring their web feeds, inversely, NGOs can monitor military feeds and stay informed, as well.

The Point

<u>Open-Standards (Web Feeds) = Interoperability & Agility</u>:

- Supporting Open-Standards facilitates efficient information sharing internally and externally with Unintended Users.
- Open-Standards supported by Strong Open-Source systems makes it easier to share information with Unintended Users.
- Web Feeds facilitate information flow and allows information to go to Unknown Users.
- Web Feeds are agile and interoperable allowing for hybrid networks of information flow.

Implications

Scale-Free Information Flow:

- Scale-Free Network of clusters of Centralized Systems providing Decentralized Content
- Sharing Information instead of Hoarding It
- Information Flows Quickly to Those Who Want It.
- Sharing Information with Unknown Users who need it.
- Users craft their own Operating Picture
- Users are not only consumers, but producers.

Where Next?

Research & Experimentation:

- Determine what Open-Standard systems to partner with. Develop Certification & Accreditation template for these systems.
- Develop systems to better use Web Feeds.
- Develop training for Administrators, Trainers, and Users in understanding and using their Information Flows.
- Refine Systems to Robustly support Standards.
- Develop Metrics for Information Flow.

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Questions?

LT Josh O'Sullivan, USN

Information Professional

jdosulli@nps.edu

Backup

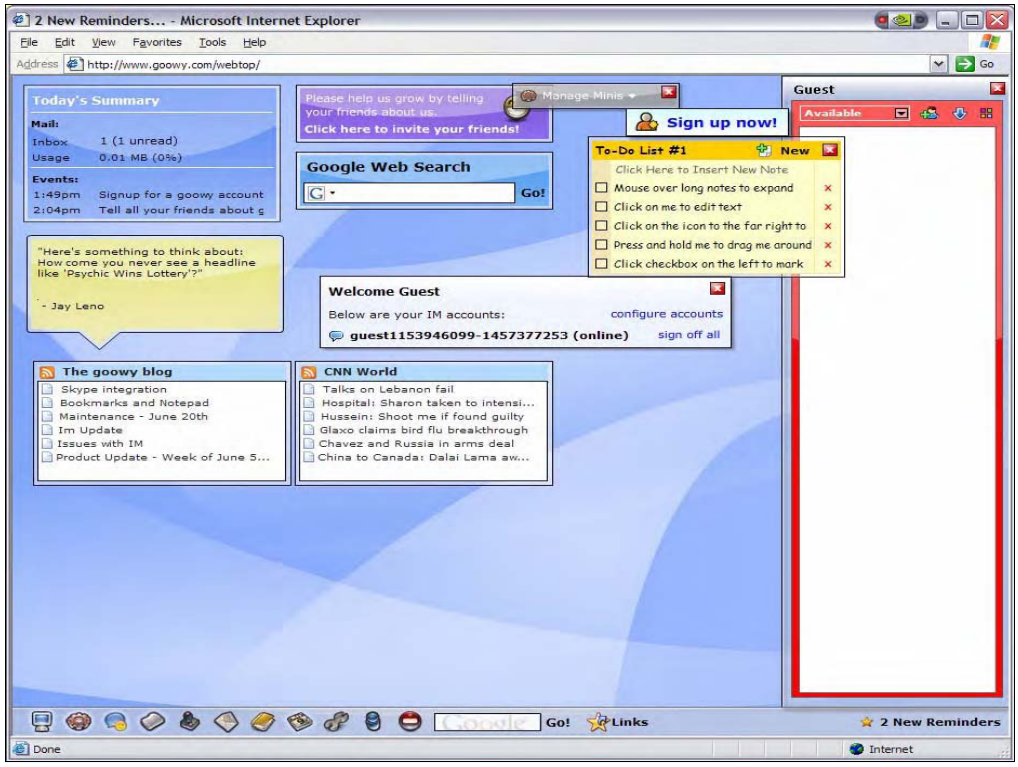
Scale-Free Networks

Web Feed Specifications

NPS Det Katrina C2 Wiki

S5

System Examples

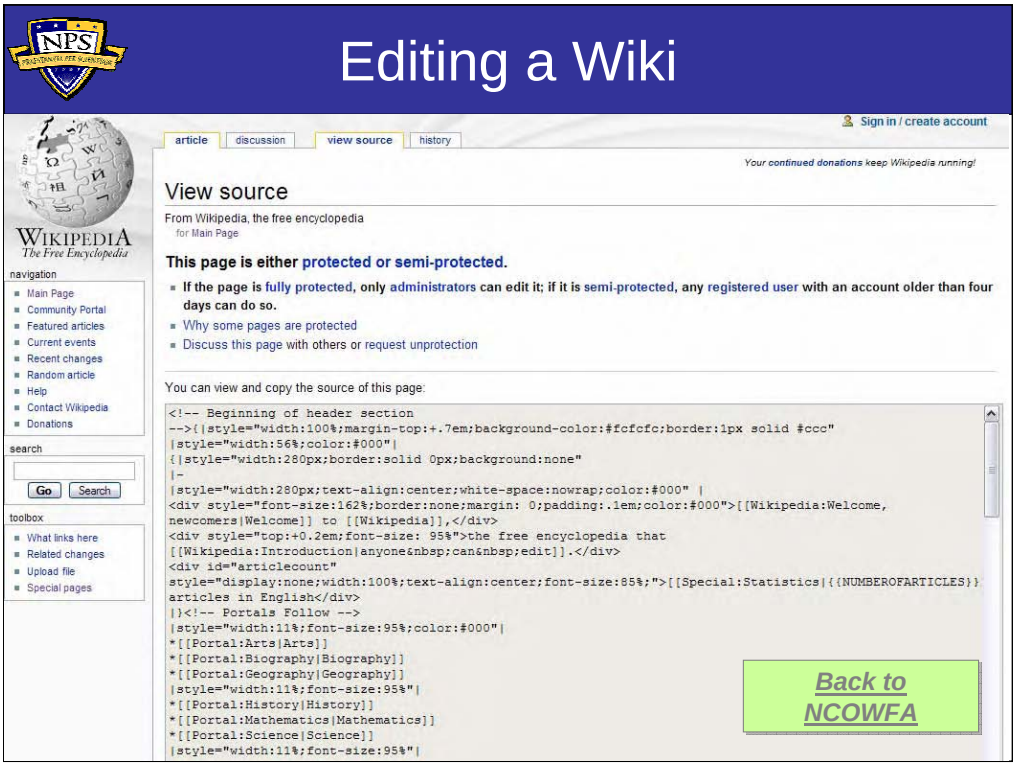

2 New Reminders... - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Address http://www.goowy.com/webtop/
Go
Today's Summary
Mail:
Inbox 1 (1 unread)
Usage 0.01 MB (0%)
Events:
1:49pm Signup for a goowy account
2:04pm Tell all your friends about g
Please help us grow by telling your friends about us.
Click here to invite your friends!
Manage Minis
Sign up now!
Google Web Search
Go!
To-Do List #1
New
Click Here to Insert New Note
Mouse over long notes to expand
Click on me to edit text
Click on the icon to the far right to
Press and hold me to drag me around
Click checkbox on the left to mark
Guest
Available
"Here's something to think about: How come you never see a headline like 'Psychic Wins Lottery'?"
- Jay Leno
Welcome Guest
Below are your IM accounts:
configure accounts
guest1153946099-1457377253 (online)
sign off all
The goowy blog
Skype integration
Bookmarks and Notepad
Maintenance - June 20th
Im Update
Issues with IM
Product Update - Week of June 5...
CNN World
Talks on Lebanon fail
Hospital: Sharon taken to intensi...
Hussein: Shoot me if found guilty
Glaxo claims bird flu breakthrough
Chavez and Russia in arms deal
China to Canada: Dalai Lama aw...
Google
Go!
Links
2 New Reminders
Done
Internet

Example of a Blog

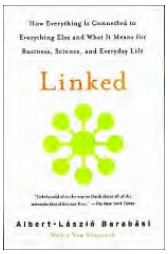
Posting to a Blog

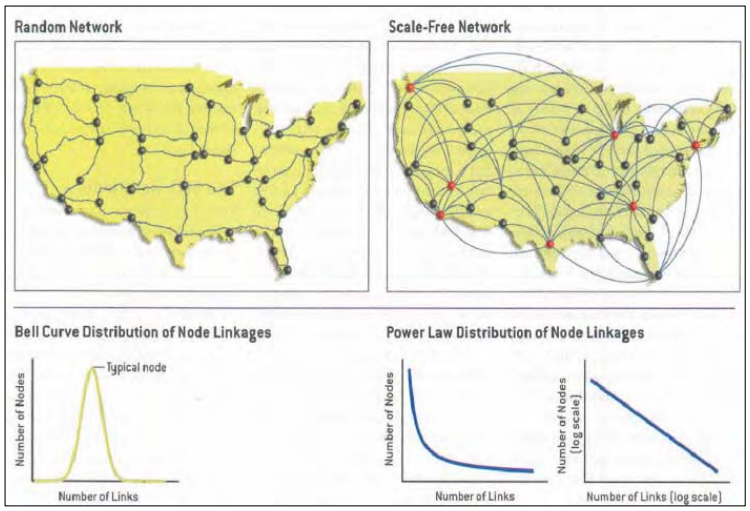
Example of A Wiki

Editing a Wiki



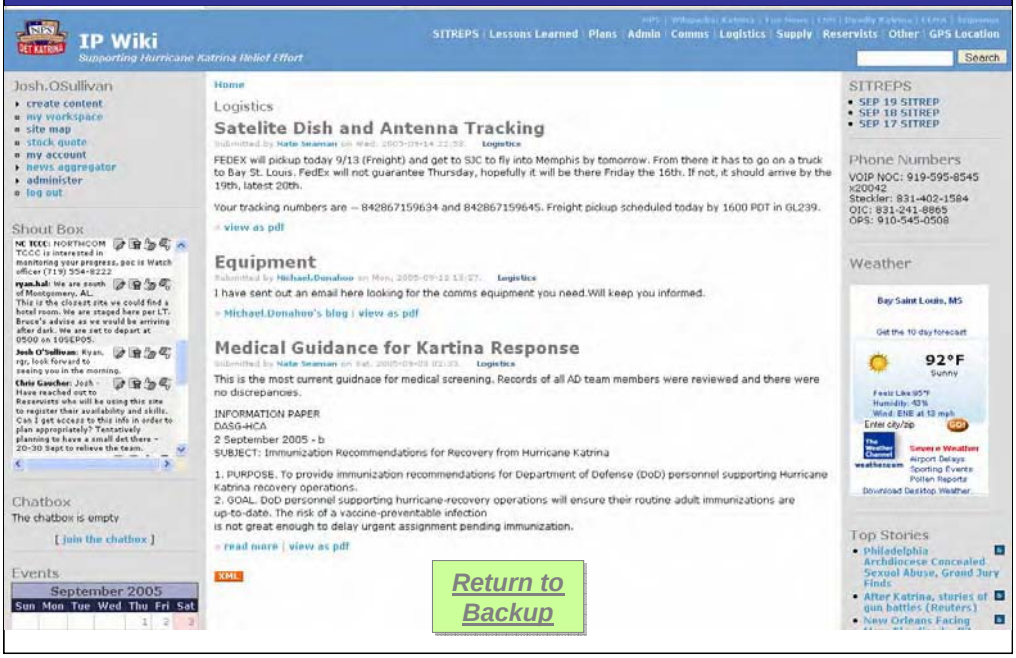
Scale-Free Networks



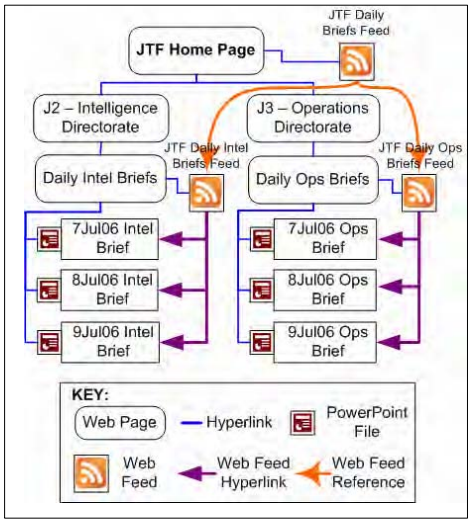


Return to Slide

NPS Det Katrina C2 Wiki

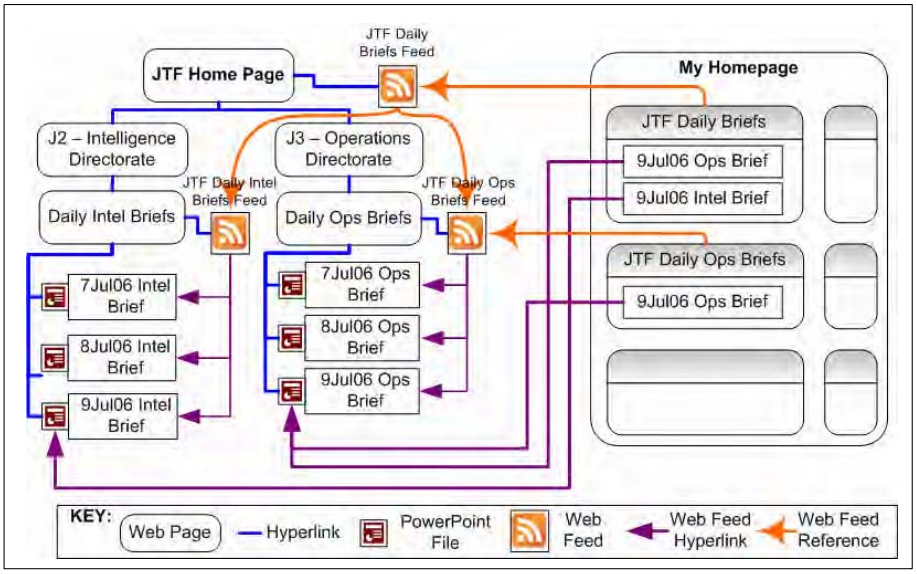


Web Feeds

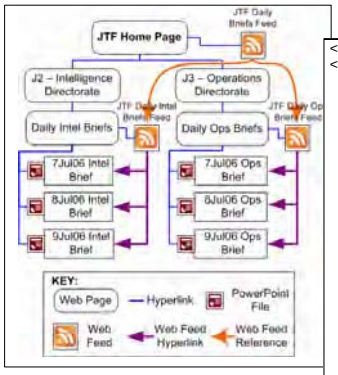


- XML 1.0 Schemas
  - RSS 2.0
  - ATOM 1.0

Web Feeds


JTF Daily Briefs Feed
JTF Home Page
My Homepage
J2 – Intelligence Directorate
J3 – Operations Directorate
JTF Daily Briefs
9Jul06 Ops Brief
9Jul06 Intel Brief
JTF Daily Intel Briefs Feed
JTF Daily Ops Briefs Feed
Daily Intel Briefs
Daily Ops Briefs
JTF Daily Ops Briefs
9Jul06 Ops Brief
7Jul06 Intel Brief
7Jul06 Ops Brief
8Jul06 Intel Brief
8Jul06 Ops Brief
9Jul06 Intel Brief
9Jul06 Ops Brief
KEY:
Web Page
Hyperlink
PowerPoint File
Web Feed
Web Feed Hyperlink
Web Feed Reference

RSS Web Feeds



RSS 2.0 Web Feed

```
<?xml version="1.0" encoding="utf-8"?>
<rss version="2.0">
   <channel>
      <title>JTF Daily Briefs</title>
      <description>The most recently available daily briefs generated
                   by the JTF.</description>
      <link>http://www.jtf.mil/</link>
      <lastBuildDate>Sun, 9 Jul 2006 18:30:02 GMT</lastBuildDate>
      <managingEditor>j6@jtf.mil (CAPT John Doe)</managingEditor>
      <category>Daily Briefs</category>
      <category>Classification: Unclassified</category>
      <item>
         <title>9Jul06 Ops Brief</title>
         <link>http://www.jtf.mil/j3/briefs/9Jul06-J3Brief.ppt</link>
         <pubDate> Sun, 9 Jul 2006 18:30:02 GMT</pubDate>
         <source url="http://www.jtf.mil/j3/DailyOpsBriefs.xml">JTF
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         <category>J3</category>
         <category>Classification: Unclassified</category>
      </item>
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         <link>http://www.jtf.mil/j2/briefs/9Jul06-J2Brief.ppt</link>
         <pubDate> Sun, 9 Jul 2006 13:23:02 GMT</pubDate>
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      </item>
   </channel>
</rss>
```
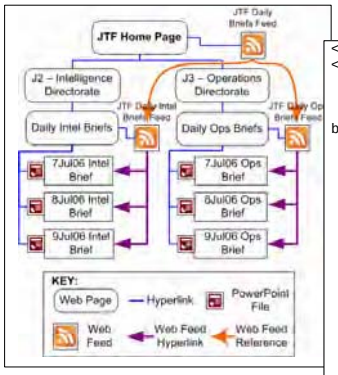

ATOM Web Feeds



ATOM 1.0 Web Feed

```
<?xml version="1.0" encoding="utf-8"?>
<feed xmlns="http://www.w3.org/2005/Atom">

   <title>JTF Daily Briefs</title>
   <subtitle> The most recently available daily briefs generated
by the JTF.</subtitle>
   <link href="http://www.jtf.mil/DailyBriefs.xml"/>
   <updated>2006-7-09T18:30:02Z</updated>
   <author>
      <name>CAPT John Doe</name><email>j6@jtf.mil</email>
   </author>
   <id>http://www.jtf.mil/</id>
   <entry>
      <title>9Jul06 Ops Brief</title>
      <link href=”http://www.jtf.mil/j3/briefs/9Jul06-J3Brief.ppt”/>
      <id> http://www.jtf.mil/j3/briefs/9Jul06-J3Brief.ppt </id>
      <updated>2006-7-09T18:30:02Z</updated>
      <category term=”J3”/>
      <category term=”Classification: Unclassified”/>
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         <title>JTF Daily Ops Briefs</title>
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         <author>
            <name>CAPT John Jones</name><email>j3@jtf.mil</email>
         </author>
      </source>
   </entry>
   <entry>
      <title>9Jul06 Intel Brief</title>
      <link href=”http://www.jtf.mil/j2/briefs/9Jul06-J2Brief.ppt”/>
      <id> http://www.jtf.mil/j2/briefs/9Jul06-J2Brief.ppt </id>
```
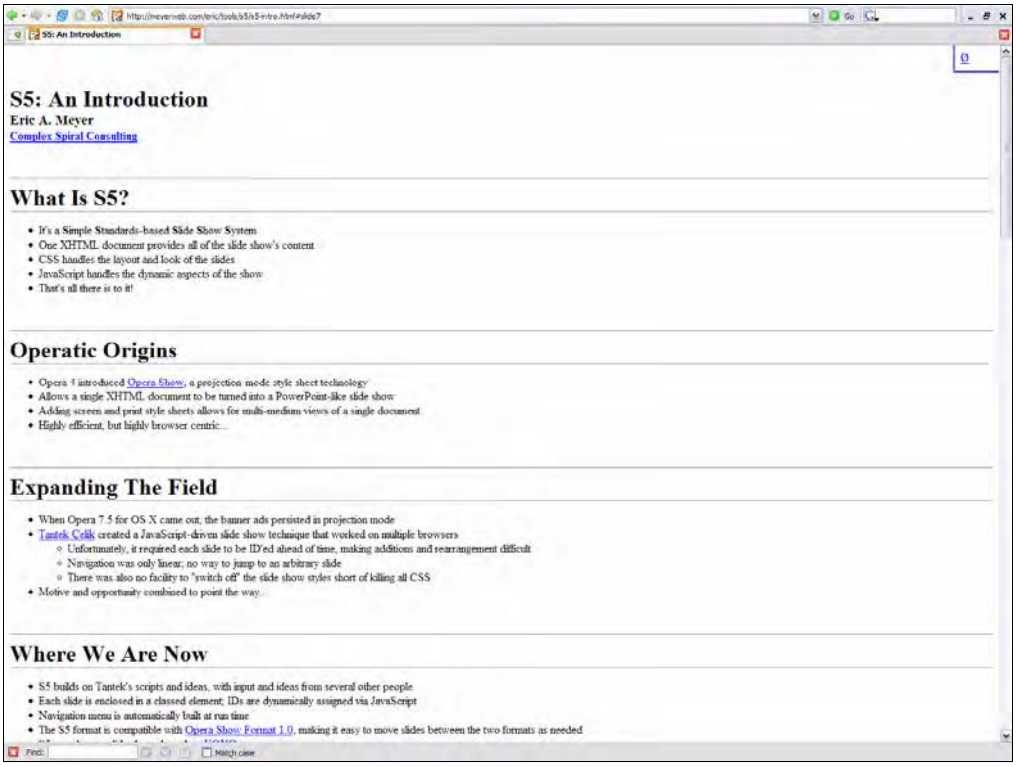
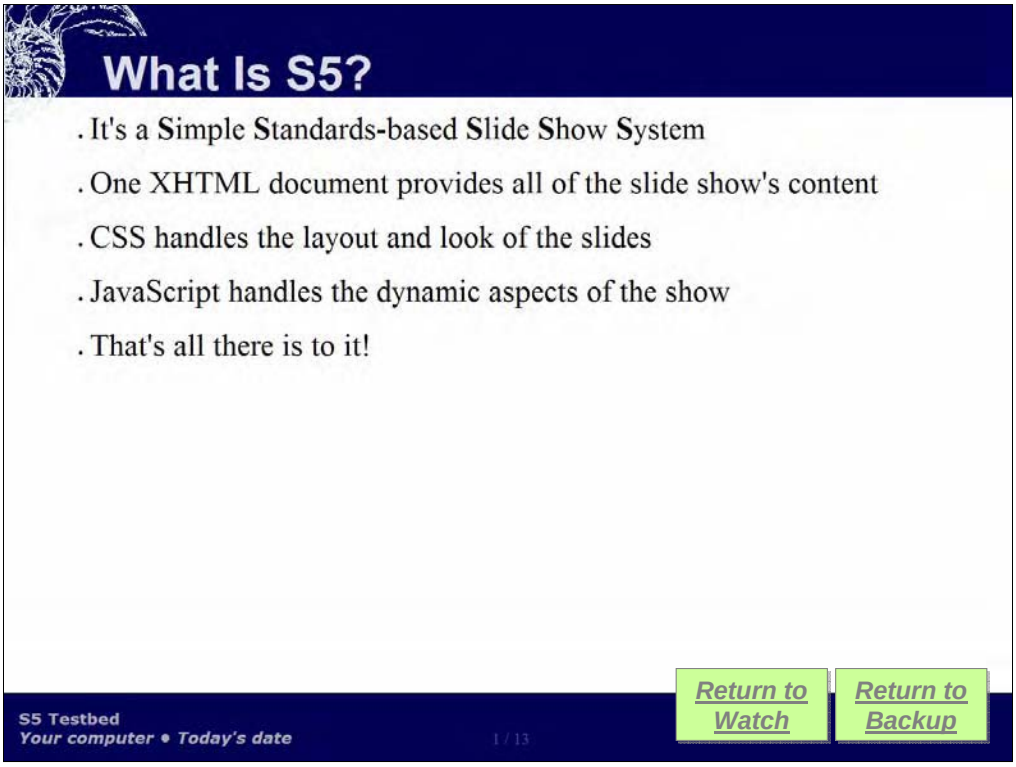

Return to NCOWFA

Return to Backup


S5: An Introduction
0
S5: An Introduction
Eric A. Meyer
Complex Spiral Consulting
What Is S5?
It's a Simple Standards-based Slide Show System
One XHTML document provides all of the slide show's content
CSS handles the layout and look of the slides
JavaScript handles the dynamic aspects of the show
That's all there is to it!
Operatic Origins
Opera 4 introduced Opera Show, a projection mode style sheet technology
Allows a single XHTML document to be turned into a PowerPoint-like slide show
Adding screen and print style sheets allows for multi-medium views of a single document
Highly efficient, but highly browser centric...
Expanding The Field
When Opera 7.5 for OS X came out, the banner ads persisted in projection mode
Tantek Çelik created a JavaScript-driven slide show technique that worked on multiple browsers
Unfortunately, it required each slide to be ID'ed ahead of time, making additions and rearrangement difficult
Navigation was only linear, no way to jump to an arbitrary slide
There was also no facility to "switch off" the slide show styles short of killing all CSS
Motive and opportunity combined to point the way...
Where We Are Now
S5 builds on Tantek's scripts and ideas, with input and ideas from several other people
Each slide is enclosed in a classed element; IDs are dynamically assigned via JavaScript
Navigation menu is automatically built at run time
The S5 format is compatible with Opera Show Format 1.0, making it easy to move slides between the two formats as needed
Find:
Match case


What Is S5?
. It's a Simple Standards-based Slide Show System
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. That's all there is to it!
S5 Testbed
Your computer • Today's date
1 / 13
Return to Watch
Return to Backup

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